



Consultative Group on International Agricultural Research

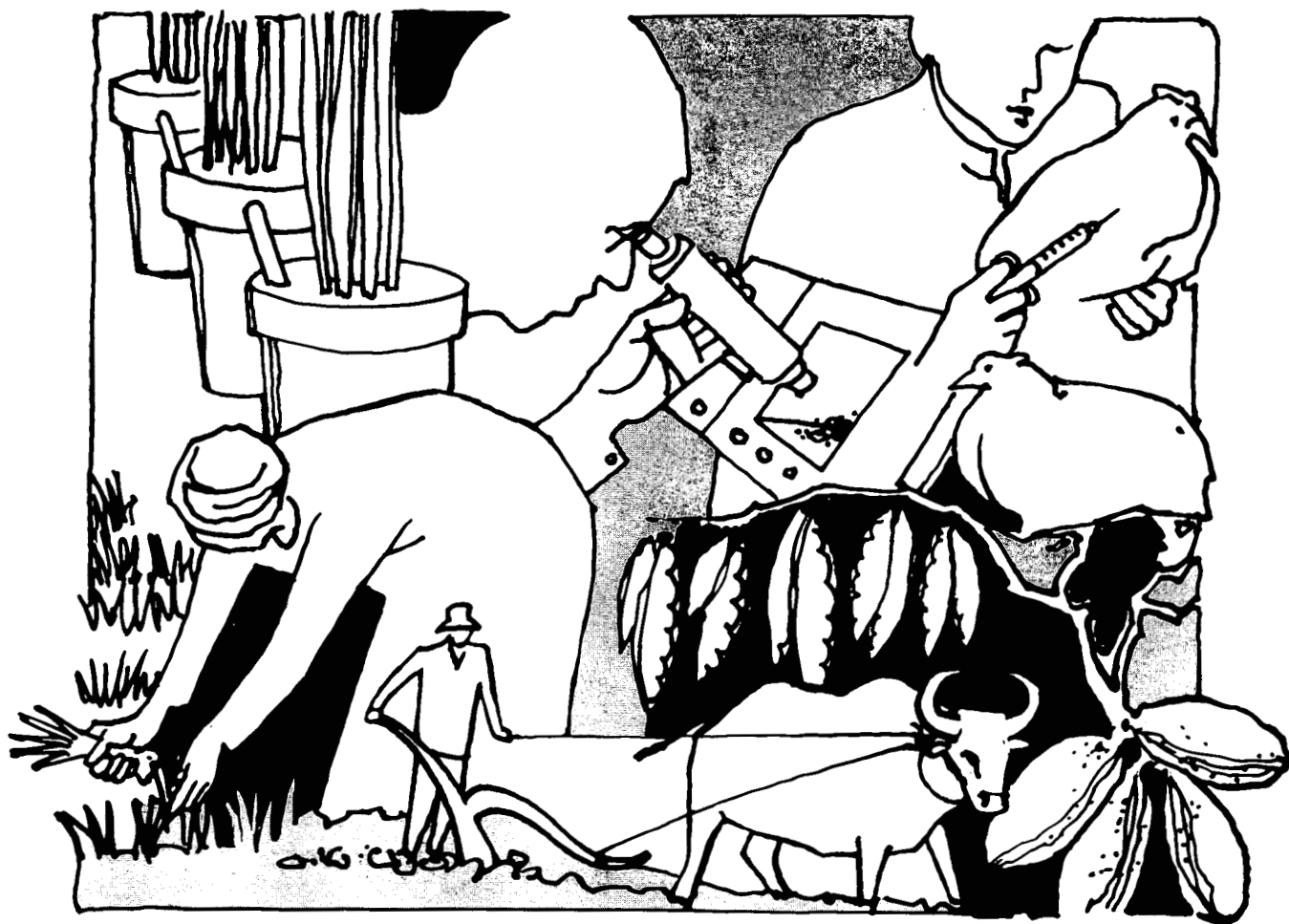
CGIAR

Study Paper Number 6

Zimbabwe and the CGIAR Centers

A Study of Their Collaboration in Agricultural Research

K. J. Billing



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At its annual meeting in November 1983 the Consultative Group on International Agricultural Research (CGIAR) commissioned a wide-ranging impact study of the results of the activities of the international agricultural research organizations under its sponsorship. An Advisory Committee was appointed to oversee the study and to present the principal findings at the annual meetings of the CGIAR in October 1985. The impact study director was given responsibility for preparing the main report and commissioning a series of papers on particular research issues and on the work of the centers in selected countries. This paper is one of that series.

The judgments expressed herein are those of the author(s). They do not necessarily reflect the views of the World Bank, of affiliated organizations, including the CGIAR Secretariat, of the international agricultural research centers supported by the CGIAR, of the donors to the CGIAR, or of any individual acting on their behalf. Staff of many national and international organizations provided valued information, but neither they nor their institutions are responsible for the views expressed in this paper. Neither are the views necessarily consistent with those expressed in the main and summary reports, and they should not be attributed to the Advisory Committee or the study director.

This paper has been prepared and published informally in order to share the information with the least possible delay.

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SUMMARY

Zimbabwe is a middle-income developing country, with a well-diversified economy, supported by a good industrial and services infrastructure.

The agricultural sector contributes some 15% to the Gross Domestic Product (excluding subsistence production) and provides some 25% of the formal employment in the country. Agricultural products represent over 40% of the total value of exports. While tobacco and sugar are major export commodities, Zimbabwe is also normally a maize exporter (with the exception of more recent years when the country experienced a series of droughts).

The agricultural sector is characterized by dualism: an advanced commercial sector produces most of the marketable surplus, and a communal sector consumes the major portion of its production and provides subsistence to about 55% of the population. There are immense differences in the level of capital and technologies employed in the two sub-sectors.

The National Agricultural Research System has been very efficient in the past and earned itself an international reputation. However, the majority of the research undertaken was oriented towards large-scale commercial agriculture. Some research-generated technological innovations have benefited the communal areas, but very little research was geared to the specific production problems facing the majority of farmers in the drier areas of the country.

Prior to Independence, political sanctions prevented all but a couple of the International Agricultural Research Centers from collaborating with the country's research organizations. Since Independence, all have begun the process of interaction and collaboration. This short involvement, while producing very little physical impact, has been enough for members of the research system to have a considered opinion on the operation and performance of these centers.

The National Agricultural Research System is undergoing a period of consolidation and reorientation, and some of the collaborative activities of the CGIAR network of centers have been useful. The research set-up has a

sound infrastructure and is reasonably funded by the Government. It is hoped that the previous record of generating useful technological packages will continue to provide equally important innovations for the smaller peasant producers who operate in the communal areas.

ACKNOWLEDGMENTS

The most important sources of information in this report have been the respondents listed in Appendix 7.1. Their frank and honest answers and their willingness to discuss their work and their impressions of the centers belonging to the CGIAR network have made the analysis possible.

After years of isolation, Zimbabwe rejoined the international community in 1980. Since that date the country has become the target of a great number of foreign appraisal missions, collecting data for the enormous volume of documents and studies that international interest in the newly independent country has generated. In the agricultural research field, the last two years have seen a large number of international officials and consultants occupying the offices and valuable time of local researchers. Given this fact and a growing phenomenon of "consultant resistance" that is occurring, the friendly and helpful interaction that I have received from the research staff interviewed has been doubly appreciated.

The IARCs have also made a contribution towards this report in two ways. Firstly, a number of centers made useful presentations to the Impact Study Seminar in Nairobi in September (CIAT, CIMMYT, CIP, IBPGR, ICRISAT, IITA, ILCA and ILRAD). Secondly, some centers have communicated to me their comments and criticisms of the draft report (CIMMYT, CIP, ICRISAT, IFPRI and ILCA). This additional information has been incorporated in the report where relevant, and cognizance has been taken of comments made by the centers.

I would like to thank Drs. Jahnke and Lagemann of GFA for their initial guidance on this study and, along with Professor Jock Anderson, for the fact that they entrusted me with this most interesting of studies.

The corrections for the final draft have been laboriously undertaken by Ms. Dorothy Marschak, co-ordinator of the CGIAR Impact Study, to whom a special mention is due.

I would like to thank my hard-working typist, Mrs. Corinne Smith, and her word processor, which have made the numerous revisions and additions to this document physically possible.

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CURRENCY EQUIVALENT

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March 1983

U.S. \$ 1.00 = Z\$ 0.96
U.S. \$ 1.04 = Z\$ 1.00

October 1984

U.S. \$ 1.00 = Z\$ 1.43
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Measurements

All measurements used are metric.

1 kilogram (kg) = 2.2 lb.
1 metric ton (t) = 2,205 lb
1 litre (l) = 2.12 U.S. Pints
1 hectare (ha) = 2.47 acres.

ABBREVIATIONS AND ACRONYMS

AFC	Agricultural Finance Corporation
AGRITEX	Department of Agricultural, Technical and Extension Services
AMA	Agricultural Marketing Authority
ARC	Agricultural Research Council
ARDA	Agricultural and Rural Development Authority
ART	Agricultural Research Trust
AVRDC	Asian Vegetable Research and Development Center
CA	Communal Area
CART	Communal Area Research Trials
CFA	Commercial Farming Area
CFU	Commercial Farmers Union
CGIAR	Consultative Group on International Agricultural Research
CGPA	Commercial Grain Producers Association
CIAT	Centro Internacional de Agricultura Tropical
CIMMYT	Centro Internacional de Mejoramiento de Maíz y Trigo
CIP	Centro Internacional de la Papa
CMB	Cotton Marketing Board
CONEX	Former Department of Conservation and Extension
CSC	Cold Storage Commission
CSIRO	Council for Scientific and Industrial Research
CSO	Central Statistical Office
DEVAG	Former Department of Agricultural Development

DMB	Dairy Marketing Board
EEC	European Economic Community
FSR	Farming Systems Research
GDP	Gross Domestic Product
GNP	Gross National Product
IARC	International Agricultural Research Center
IBPGR	International Board for Plant Genetic Resources
ICIPE	International Center of Insect Physiology and Ecology
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IDA	International Development Association
IDRC	International Development Research Center
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IITA	International Institute of Tropical Agriculture
ILCA	International Livestock Center for Africa
ILRAD	International Laboratory for Research on Animal Diseases
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
LSCFA	Large-Scale Commercial Farming Areas
MoA	Ministry of Agriculture
MLRRD	Ministry of Lands, Resettlement and Rural Development
NCI	No-(foreign) Currency Involved
NARS	National Agricultural Research System
ODA	Overseas Development Authority
R&SS	Department of Research and Specialist Services
SSCFA	Small Scale Commercial Farming Areas
SADCC	Southern African Development and Co-ordination Conference
TMB	Tobacco Marketing Board
TRB	Tobacco Research Board
UDI	Unilateral Declaration of Independence
USAID	United States Agency for International Development
ZASA	Zimbabwe Agricultural and Scientific Assistance Program
ZSMA	Zimbabwe Seed Maize Association

CHAPTER ONE

BACKGROUND INFORMATION

1.1 The Study

The purpose of this study is to assess the impact that the International Agricultural Research Centers (IARCs) collaborative efforts have had in Zimbabwe. The study has been commissioned by the Consultative Group on International Agricultural Research (CGIAR) in Washington as part of a world wide study into the impact of the thirteen existing IARCs.

The measurement or evaluation of impact by any organization, innovation or idea is essentially extremely difficult. The complementary factors and inter-relationships that exist in any situation are difficult to separate and to attempt to determine the effect of a single component in isolation from these other factors has always been problematic. This impact study is fraught with just such difficulties.

In some cases where the output of an IARC is a new crop variety, the quantification may appear simpler, but even in this situation, a number of secondary influences in the form of extension, credit, and marketing may play a more important role in the diffusion of the variety than its simple genetic suitability. Placing some economic value on the effect of the new variety may be extremely complex given the various factors that may have facilitated its adoption.

The data base on past and present agricultural practices and production is notoriously sparse in most developing countries and Zimbabwe is no exception. This deficiency in knowledge about the pre-introduction situation does not lend itself to an easy

measurement of the overall production increases that result from the release of a new variety or techniques.

Where the output of an IARC is in the form of advice, ideas, information or even training of local personnel, the measurement of impact is even more difficult. The effect of these forms of input into the National Agricultural Research System (NARS) may only result in improved performance at a much later date and this may be impossible to quantify.

Given these limitations on the measurement of any impact, this study has had to rely on the personal views and opinions of those interviewed. Thus, this report contains more of a collection of personal interpretations of perceived impact than any detailed economic evaluations of actual impact.

For this no excuses are offered. One of the expressed purposes of the IARCs is to support and aid the NARS in the countries in which they operate. Thus the perceptions of their effects on the NARS and on the country's agriculture by personnel in the system is possibly the most practical way in which the CGIAR will be able to evaluate the impact of the IARCs.

The selection of personnel to be interviewed has been based on the following criteria:

- 1) The respondent had something to contribute in the form of knowledge of the agricultural sector, the NARS, or because of involvement with an IARC.
- 2) Ensuring that all the IARCs which have had any involvement in Zimbabwe have been included.

The application of these two criteria has led to a naturally biased sample which precludes any quantitative analysis of the responses. Each interview was conducted on the basis of a prepared questionnaire, but the respondents were given considerable latitude to express their impressions and to digress into the more general aspects of the agricultural sector in Zimbabwe, as well as enabling them to give their views on the role and future direction of agricultural research in the country. Where respondents were hard pressed for time, only the essential portion dealing with their involvement with IARCs was covered. Some respondents naturally had no direct involvement with an IARC but their views on the broader issues facing research and general agriculture have made an equally valuable contribution to this report.

One obvious problem of the research method is that the individuals interviewed may have strong views on an IARC which is based solely on his or her personal perception. Where this has happened, the centers mentioned have responded with additional information and their version of the facts.

These rejoinders to statements made in the original draft have been included under the relevant sections. Some of the comments from centers were based on their reading of the original summary which has now become Section 5 of this report. In these cases it is hoped that the Center's objections will have fallen away once they studied the complete report. It is interesting to note that most of the correspondence from the centers was a result of implied or actual criticisms of their performance or concern that their activities had not been fully elucidated. It is encouraging to note that the IARCs are sensitive to this type of study and if the IARCs respond in a positive fashion by correcting their mistakes and deficiencies, then the whole Impact Study will have had some benefit.

A general criticism of research scientists world wide has been that they often work within their own narrow specialisation without considering the ultimate effect of their own research efforts. On the basis of the interviews conducted, it is apparent that many Zimbabwean scientists exhibit elements of this problem. Many respondents found it difficult to discuss what they thought the future impact and consequences of their research findings might be.

It was encouraging however to find that many hoped that their work would go some way towards alleviating hunger, increasing agricultural production and improving the standards of living of farmers. These noble sentiments are in fact the main objectives and driving force behind the whole CGIAR network and the basis on which a considerable number of donors make financial contributions to the system of IARCs.

1.2 Zimbabwe

1.2.1 Natural Setting

Zimbabwe is situated in southern Central Africa lying approximately between longitude 25° East and 33° East and Latitude 15°30' South and 22°30' South.

Topographically, the country is dominated by a large plateau in the central and northern parts where the altitude is generally above 1,200 m and rises occasionally to over 1,700 m. The northern and southern boundaries are formed by the Zambezi and Limpopo rivers whose valleys vary between 900 - 600 m and 600 - 300 m respectively. The eastern border with Mozambique is formed by a ridge of mountains running North to South where altitudes reach almost 2,600 m. To the west of the eastern highlands is the Sabi River (the other major drainage line) which runs south into the Limpopo. The country is often divided locally into two broad natural environments. These include the highveld (the area on the plateau) and the lowveld (the areas of low altitude in the north, south and southeast of the country). In addition, some call the intermediate area between these two, the midveld.

a) Rainfall

The total mean annual rainfall in Zimbabwe experiences considerable variation with topography ranging from over 1,200 mm in the Eastern Highlands to below 600 mm in the lower lying valleys. The country experiences a unimodal rainy season between November and April. On the basis of total effective annual rainfall and incorporating a measure of the probability of there being a dry spell during the growing season, the country is divided into 5 agroecological zones.

Table 1: Agroecological Zones or Natural Regions in Zimbabwe.

NATURAL REGION I

Characteristics:	High rainfall of more than 1,000 mm per annum with normally some precipitation in all months. Comparatively low temperatures ensure highly effective rainfall.
Recommended Use Based on Farming System:	Aforestation, deciduous and sub-tropical fruits, tea and coffee
Distribution:	Along the Eastern border range.
Percentage of Total area of country:	2%

NATURAL REGION II

Characteristics:	Rainfall is confined to summer and is moderately high (750-1,000 mm). The region normally enjoys reliable rainfall and rarely experiences severe dry spells in summer.
Recommended Use Based on Farming System:	Suitable for intensive system of farming based on both crops and livestock
Distribution:	The major northern portion of the central plateau and parts of the eastern highlands.
Percentage of Total area of country:	15%

NATURAL REGION III

Characteristics:	Rainfall is moderate in total amount (650-800mm) but because much of it is accounted for by infrequent heavy falls and temperatures are generally high, its effectiveness is reduced. The region often experiences fairly severe mid-season dry spells.
Recommended Use Based on Farming System:	Suitable for semi-intensive system of farming where mid-season dry spells make any enterprise based solely on crops slightly marginal.
Distribution:	The southern and eastern portions of the central plateau.
Percentage of Total area of country:	19%

NATURAL REGION IV

Characteristics:	Experiences fairly low total rainfall (450-650mm) and it is subject to periodic seasonal droughts and severe dry spells during the rainy season.
Recommended Use Based on Farming System:	The rainfall is generally too low and erratic for cash cropping except in certain very favourable conditions. Drought resistant crops and livestock would be the recommended enterprise pattern.
Distribution:	The northeastern and western areas of the country.
Percentage of Total area of country:	38%

NATURAL REGION V

Characteristics:	The rainfall is low (below 650mm) and generally erratic. High temperatures greatly reduce its effectiveness.
Recommended Use Based on Farming System:	The rainfall makes crop production a marginal activity and the most useful enterprise pattern would be extensive cattle ranching.
Distribution:	The Zambezi and Sabi-Limpopo Valleys.
Percentage of Total area of country:	27%

The above classification is based on Vincent and Thomas as revised in 1978. The recommended enterprise patterns are presented, although these largely apply to commercial farming activities as will be shown in Section 1.3.

1.2.2 Population

The 1982 census in Zimbabwe enumerated 7,546,071 inhabitants. The census has been criticized for being an underenumeration because of the security situation in some areas, language problems in other areas and the highly mobile and temporary resident lodgers in the

urban areas. However, the census is accepted by most as reasonable and within the normal variation expected.

Between 1969 and 1982 the population grew at an annual rate of 3.1% per annum. The major divisions in Zimbabwe and their respective populations are given in Table 2 below. Other areas include National Parks, Safari and Forest Areas.

Table 2: Population of Zimbabwe at 1982 Census on the Basis of all Land Categories

Land Category	No.	%
Communal Areas	4,173,278	55.3
Large Scale Commercial Farming Areas	1,090,306	14.5
Small Scale Commercial Farming Areas	164,323	2.2
Resettlement Areas	129,494	1.7
Municipalities	1,673,057	22.2
	1,956,032	25.9
Towns and Mines	282,975	3.7
Other Areas	32,638	0.4
Total	7,546,071	100.0

Source : 1982 Population Census : A Preliminary Assessment, Central Statistical Office, February, 1984.

1.2.2.1 Population Density

a) Communal Areas

The Communal Lands vary considerably in population densities. An arc of heavily populated CAs runs from Mberengwa in the southwest through Masvingo to Mutoko in the northeast. In this area population densities of between 30-70 inhabitants per sq. km. are found. Along the eastern border some small communal areas currently have extremely high population

densities (77 inh/sq.km in the Honde Valley and 150 inh/sq.km in Ngorima CA). These high populations are thought to be a result of returning Zimbabwean refugees moving back across the border and an influx of refugees from Mozambique.

In the extreme south and west, population densities of the CAs tend to be lower, averaging 16 inh/sq.km. In the northern portions of the country population densities in the CAs are even lower, often below 10 inh/sq.km.

The national average for all Communal Areas is 25.6 inh/sq.km.

b) Commercial Farming Areas

The average population density is about 9 inh/sq.km although this again varies considerably from 38.2 in Manicaland and 35.2 in Mashonaland East to 3.6 and 2.6 in Matabeleland North and South.

c) Urban Areas

Zimbabwe, like most developing countries, has experienced a rapid growth of its urban population from 942,800 in 1969 to 1,941,610 in 1982 which represents an average annual growth rate of 5.7% per annum. Currently, some 25.9% of the population is resident in urban areas.

1.2.3 The Economy

Zimbabwe has an extremely well diversified economy with advanced industrial and monetary sectors. Its mineral resources include gold, asbestos, nickel, iron ore, ferro-chrome, coal and copper, while its

major agricultural products include tobacco, maize, cotton, wheat, sugar, groundnuts, soya beans, beef and dairy products.

Zimbabwe is classified as a middle income country by the World Bank with a GNP per capita of US\$ 470 - (World Bank, 1980). The economy, however, is characterised by dualism, which is reflected in gross income and wealth inequalities between and within economic sectors and between different population groups.

Table 3: Zimbabwe - Gross Domestic Product (GDP) at Factor Cost, Population, and GDP per Capita - Selected Years.

	1965	1974	1979	1981
Current GDP (Z\$M)	737	1,859	2,627	4,350
GDP in 1965 Prices (Z\$M)	737	1,357	1,187	1,554
Population (Million)	4.5	6.1	7.2	7.6
Current GDP per capita (Z\$)	164	305	365	572
GDP per Capita 1965 prices	164	223	165	204

Source: World Bank, Zimbabwe Agricultural Sector Study 1983

Discrepancies between these figures and those in the CSO Quarterly Digest are not explained by the Bank report.

Real growth in the economy between 1965 and 1974 was high, averaging 7% per annum. This growth far outstripped population growth and was largely a result of international financial and economic sanctions which led to a closer integration of the various sectors of the economy and a substantial increase in output. The economy underwent significant structural changes because of diversification and import substitution.

From 1974-1979 foreign exchange shortages, call-ups of personnel for military service, two droughts, lower investment and increasing

Government consumption for defense all contributed to declines in economic activity. The 2.7% average annual rate of decline in real GDP during this period, coupled with a continued increase in population reduced real per capita GDP back to its 1965 level. In 1980 and 1981, GDP rose rapidly at 11.2% per annum returning the per capita GDP to where it was around 1971/72. Real per capita GDP growth between 1965 and 1981 averaged 1.4% per annum. A series of droughts in 1981/82, 1982/83 and 1983/84 have lead to a subsequent decline in the overall performance of the economy, real growth in GDP in 1982 being -3.0%.

1.2.3.1 Sector Contribution to GDP

The contribution made to total GDP by the various sectors is presented in Table 4 below:

The main structural changes in the economy during the period under consideration have been the decline in the agricultural sector's contribution to GDP and a corresponding increase in that of the manufacturing sector. The recent world recession is reflected in the depressed contribution made by the mining sector in 1982.

Table 4: Gross Domestic Product at Factor Cost by Industry of Origin
- Selected Years (Z\$ Million).

	1965		1974		1979		1982	
	Value	%	Value	%	Value	%	Value	%
Agriculture & Forestry	123	18	315	18	329	13	670	15
Mining	48	7	136	7	226	9	243	5
Manufacturing	135	20	421	24	623	25	1096	25
Electricity & Water	21	3	42	2	71	3	77	2
Construction	82	5	82	5	92	4	150	3
Finance, Ins. & Real Estate	41	6	119	7	167	7	277	6
Distribution, Hotels, Restaurants	104	15	258	14	313	12	656	15
Transport and Communication	55	8	138	8	188	7	356	8
Public Admin.	33	5	109	6	269	10	357	8
Education and Health	31	5	88	5	161	6	420	9
Domestic Service	21	3	40	2	53	2	85	2
Other Services		7	85	5	136	5	272	6
Less Imputed Banking Service Charges	-11	-2	-42	-2	-82	-3	-194	-4
Total	683	100	1,791	100	2,546	100	4,465	100

Source : CSO Quarterly Digest of Statistics

1.2.3.2 Formal Sector Employment

Just over one million workers were reported to be in wage employment in 1983. Table 5 shows the totals and percentage breakdown by sector.

In the decade of vigorous industrial growth that followed the application of sanctions, 1965/75, the formal wage sector absorbed approximately 30,000 new entrants a year. Jobs in the commercial sector of the economy grew at 4% per annum. Commercial agriculture increased its employment at 2% per annum.

Table 5: Zimbabwe - Employees (in Thousands) by Industrial Sector - Selected Years

	1965		1974		1979		1980		1982		1983	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
Agriculture and Forestry	295.6	40	365.6	35	335.2	34	327.0	32	274.3	26	263.5	25
Mining	47.1	6	62.0	6	59.5	6	66.2	7	63.7	6	60.3	6
Manufacturing	80.7	11	151.3	15	144.7	15	159.4	16	180.5	17	173.4	17
Electricity and Water	4.9	1	6.9	1	6.6	1	6.7	1	6.5	1	6.9	1
Construction	27.2	3	64.3	6	40.6	4	42.2	4	51.1	5	49.3	5
Finance, Insurance, Real Estate	7.9	1	11.6	1	12.1	1	12.5	1	14.6	1	15.8	1
Distribution, Hotels and												
Restaurants	60.8	8	76.2	7	67.6	7	70.3	7	79.8	8	80.6	8
Transport and Communication	35.3	5	43.8	4	43.4	4	45.6	4	50.4	5	49.6	5
Public Administration	29.9	4	43.4	4	73.7	8	71.1	7	81.3	8	82.5	8
Education and Health	38.2	5	47.7	5	48.6	5	57.1	6	90.7	9	97.2	9
Private Domestic	94.7	13	124.4	12	110.4	11	108.0	11	101.4	10	99.8	10
Other Services	25.2	3	42.7	4	42.3	4	43.8	4	51.7	5	54.5	5
Total	747.5	100	1,039.9	100	984.7	100	1,009.9	100	1,045.9	100	1,033.4	100

Source : CSO Quarterly Digest of Statistics.

This period of growth was followed by 5 years of stagnation and decline (1976/80). There was a negative growth rate of about 1% per annum in jobs. The manufacturing sector employment continued to expand slowly, but there was a major slump in commercial agriculture.

After Independence, the economy expanded rapidly. Employment in commercial agriculture continued to decline in response to political uncertainty and the Government's minimum wage policy, with some 33,000 jobs lost in 1981. An increase of 9% in the jobs available in the manufacturing sector and a rapid increase in employment in education off-set this and employment grew at 3% per annum in 1981, adding an additional 28,000 jobs.

1982 saw a small increase in employment, while in 1983 the total number of jobs fell to below the number in 1981.

A serious un- and under-employment situation now exists in Zimbabwe. It is estimated that employment would have to grow at 8% per annum to clear the backlog of those seeking employment and to meet the aspirations of new job seekers. Recent economic performance does not suggest that this will be possible.

Despite the above, about 30% of all adults earn wages and this fact makes Zimbabwe very different from most countries in Africa.

1.2.3.3 External Trade

In 1965 the settler Government unilaterally declared independence from the United Kingdom. This action led to the implementation of international sanctions. The Government at that time introduced stringent import controls and strove to maintain a positive visible trade balance. The UDI period ended with the election of the majority rule Government in 1980. On the lifting of sanctions, the

country achieved a marked expansion in exports. In 1981 exports were 8% higher in value terms than in 1980. However, imports grew much more rapidly in post-Independent Zimbabwe, and the country experienced its first negative trade balance in 14 years. The 15 years of sanctions had resulted in an aging stock of plant and machinery and Government has gone some way towards allowing the importation of new equipment. The Government had liberalized the remittance of profits at Independence and this coupled with substantial white immigration contributed to the negative trade balance.

In December, 1982 the country devalued its currency by about 20% and in 1984 introduced extraordinary measures to prevent the continued outflow of currency in the form of dividends and rents to former residents. The country is currently experiencing an extremely serious foreign currency shortage because of food imports necessitated by the drought and the continued international recession. Import allocations have been drastically reduced, and recently the country has expanded its export incentive scheme.

Unless there is an improvement in the current foreign exchange situation, it is likely that the continued inadequate allocations to the manufacturing sector will result in a serious drop in output and consequently a fall in employment.

Table 6: Zimbabwe - Summary of External Trade in Z\$ Million

Period	Domestic Exports	Gold Sales	Re- Exports	Total Exports	Total Imports	Visible Balance
1964	230.4	14.2	30.3	274.8	216.6	58.2
1965	278.4	13.6	30.9	322.0	239.6	83.2
1966	171.0	-	17.0	188.0	186.5	15.6
1967	169.9	6.4	12.1	188.4	187.1	1.3
1968	167.5	16.3	8.5	192.3	207.1	-14.8
1969	212.2	11.8	6.8	230.8	199.5	31.3
1970	245.1	7.6	6.1	258.7	235.0	23.8
1971	266.3	17.5	6.5	290.2	282.5	7.8
1972	322.2	20.7	6.2	349.1	274.7	74.4
1973	377.8	5.0	6.3	389.1	308.6	80.5
1974	482.1	42.5	6.5	531.2	438.3	92.8
1975	477.7	45.3	8.2	531.3	461.9	69.4
1976	518.2	34.6	4.6	557.4	382.7	174.7
1977	500.8	45.7	4.4	550.8	388.1	162.7
1978	558.7	46.1	4.6	609.3	403.7	205.6
1979	645.4	66.6	3.7	715.7	549.3	166.4
1980	787.5	115.2	6.5	909.2	809.4	99.8
1981	888.1	76.3	7.3	971.7	1071.7	-46.0
1982	807.2	140.5	20.7	968.4	1081.8	-113.4
1983	935.4	105.5	21.6	1062.5	1073.9	-11.4

Source: CSO Quarterly Digest of Statistics.

Note: These figures include transactions where no currency is involved - these mainly involved migrant's effects. Excluding these NCI transactions, the visible trade balance in 1981 and 1982 deepened to Z\$ -69.7 and Z\$ -142.0 millions respectively. Figures for 1983 are extrapolated on the basis of the period January-October.

A brief review of the component breakdown of Exports and Imports is given below for the period 1979-1983.

a) Domestic Exports (Table 7)

Zimbabwe's dependence on the mining sector as a source of foreign exchange increased significantly during 1983. The value of mineral exports, excluding gold sales, rose by 35% and accounted for approximately 45% of export earnings.

Table 7 : Domestic Exports by Main SITC Sections for Period 1979 - 1983 (Excluding Gold Sales)

Category	Z\$ MILLIONS									
	1979		1980		1981		1982		1983	
	Value	% of Total Exports	Value	% of Total Exports	Value	% of Total Exports	Value	% of Total Exports	Value	% of Total Exports
Foodstuffs	109.7	17	102.4	13	133.2	15	129.1	16	140.3	15
Beverage and Tobacco	83.9	13	126.1	16	22.0	25	193.7	24	196.4	21
Crude Materials Excluding Fuels	148.4	23	173.4	22	168.7	19	145.3	18	177.7	19
Manufactured Goods	212.9	33	283.7	36	239.8	27	234.0	29	308.6	33
Miscellaneous	90.3	14	102.4	13	124.3	14	104.9	13	112.2	12
Total	645.0	100	788.0	100	888.0	100	807.0	100	935.0	100

Source : RAL Executive Guide to the Economy : June 1984.

After tobacco and gold, chrome and nickel are Zimbabwe's most important export commodities accounting respectively for 9% and 7% of total export earnings.

Although the value of agricultural exports rose to \$425 million in 1983, the sector share of total exports fell to 45%.

Exports of finished manufactured goods fell to about \$103 million in 1983 from \$113 million in 1982.

b) Imports (Table 8)

The total value of imports remained fairly static in 1983 falling by about 1% to an estimated \$1074 million. The most notable trend in Table 8 below is the dramatic increase in the value of machinery and transport imports since Independence. The goods imported under this heading entered the country in response to pleas for development aid and were either donated or provided on special terms.

The second largest category of imports, accounting for more than 20% of the total value is fuels and electricity. This situation is a common problem facing non-oil producing developing nations where fuel bills have risen greatly since the mid seventies.

Table 8 : Imports by main SITC Sections for Period 1979 - 1983

Category	Z\$ MILLIONS									
	1979		1980		1981		1982		1983	
	Value	% of Total Imports	Value	% of Total Imports	Value	% of Total Imports	Value	% of Total Imports	Value	% of Total Imports
Machinery and Transport Eqpt.	126.3	23	210.3	26	346.1	34	44.2	11	343.7	34
Fuels & Electricity	164.7	30	194.2	24	213.8	21	183.9	17	236.3	22
Chemicals	76.9	14	105.2	13	142.5	14	129.8	12	150.4	14
Manufactured Goods	93.3	17	153.7	19	193.4	19	262.3	15	150.4	14
Miscellaneous	87.8	16	145.6	18	142.5	14	162.3	15	171.8	16
Total	549.0	100	809.0	100	1018.0	100	1082.0	100	1074.0	100

Source : RAL Executive Guide to the Economy : June 1984.

1.3 The Agricultural Sector

1.3.1 Structure

The major feature of the Agricultural Sector in Zimbabwe is its division into commercial and communal sub-sectors.

1.3.1.1 Commercial Farming Area

The commercial sub-sector comprises about 5,400 large-scale farms occupying some 15.6 million hectares. Only 4,800 of these farms were active at the end of 1982 and some areas had been acquired for resettlement (see section 1.3.1.3 for further details). The majority of land owners in this group are white (land is owned under the freehold system) and the area used to be classified as the European commercial farming area, but under post-Independence legislation it is now called the large-scale commercial farming area (LSCFA).

In addition to the LSCFA there is what is now known as the small scale commercial farming areas (SSCFA) formerly the African Purchase Areas. These are occupied by some 9,000 blacks and comprise some 1.5 million ha. In these areas there was originally leasehold with an option for later freehold ownership. Currently the majority of this area is under freehold title with some still in the leasehold phase.

1.3.1.2 Communal Farming Area

The communal sub-sector comprises some 174 separate Communal Areas covering some 16.4 million ha. These areas, collectively known as the Communal Lands (formerly Tribal Trust Lands), are the home of some 700,000 farming families. Land in this area is held under

traditional usufructory tenure rights. Each family has almost permanent tenure of its arable area and the right to run livestock on communally owned grazing area. Land allocation was traditionally the right of tribal leaders like chiefs and headmen. Legislatively this is now one of the functions of the District Council (an elected local Government organization) but most land allocations are still handled by traditional leaders.

1.3.1.3 Resettlement Areas

The Government of Zimbabwe embarked at Independence on an ambitious resettlement program to redress the imbalance between land allocated to whites and blacks. To date, the Government has acquired 540,000 ha of formerly commercial land which with some 130,000 ha of state land has been used to resettle communal area families.

1.3.2 Infrastructural Support

1.3.2.1 The Ministry of Agriculture

The Ministry of Agriculture is divided into three Branches: Professional and Technical Services Branch, Economics and Marketing Branch and an Administrative and Finance Branch. Each branch is headed by a Deputy Secretary who is responsible through the Permanent Secretary to the Minister and his deputy. The Administrative and Finance branch provides a financial and staff administrative and accounting service to the Ministry.

The Economics and Marketing Branch advises the Minister on all economic matters and plays a pivotal role in the annual review of producer prices. The Professional and Technical Services Branch comprises:

the Agricultural Education Branch, which is responsible for all post-secondary agricultural training institutes;

the Department of Research and Specialist Services;

the Department of Agricultural, Technical and Extension Services (AGRITEX) and,

the Department of Veterinary Services.

In this section only the extension and veterinary services will be described as the research section will be fully covered in section 2.2

a) Extension

The provision of an extension service to farmers in Zimbabwe has, in the past, been divided on the basis of the main divisions of the sector into Commercial and Communal Areas. In the last twenty years the extension service has often been divided between 2 different ministries.

In 1981 the two extension services DEVAG and CONEX were merged into the Department of Agricultural, Technical and Extension Services (AGRITEX) again under MoA.

AGRITEX has two main sections, Field Services and Technical Services. The Field Services Section has approximately 1,900 staff members arranged on the basis of eight provincial offices and some 52 regions. At the present time there is approximately one extension worker at a grass roots level for every 750 farm families. The Technical Services section has some 330 staff positions organized into seven specialised subject matter branches:

- | | |
|----------------------|-----------------------|
| 1) Animal Production | 5) Veld and pastures |
| 2) Crop Production | 6) Planning (land use |
| 3) Engineering | and farm management) |
| 4) Irrigation | 7) Training. |

This section is responsible for preparing the extension packages for the field services, while its planning Branch has an important relationship to the Department of Resettlement in connection with land use planning for intensive resettlement schemes.

Since its formation, AGRITEX has embarked on a policy of expanding the extension provided to small holder Communal Areas farmers. This shift in policy in Agritex has necessitated the provision of an advisory service only (mainly on-call) to the commercial farmers. This is reasonable, given the fact that most of these farmers are already very knowledgeable and self-reliant.

b) Veterinary Services

The Department of Veterinary Services has, since its establishment, been responsible for the prevention and control of animal diseases in the country. Prior to Independence, the Department confined itself to disease regulatory activities and was basically a specialist rather than an extension service. Since Independence there has been a considerable change in policy. The department has taken over the dipping services in CAs. It has, in the last two years opened a training school which will produce some 250 Veterinary Assistants who will be permanently posted in the CAs where they will be based at animal health care and management centers. These centers are currently being constructed under various donor aid programs.

1.3.2.2 The Ministry of Lands, Resettlement and Rural Development

MLRRD is responsible for the resettlement program in Zimbabwe. This alone makes it an important force in agriculture. In addition, the Ministry has jurisdiction over the co-operative movement, small irrigation schemes and general rural development planning and monitoring. MLRRD also is responsible for the Agricultural and Rural Development Authority (ARDA).

a) The Co-operative Movement

MLRRD is responsible for the promotion and development of co-operatives. It services the movement through training and the audit of co-operative societies.

The Government has a clearly stated commitment to the establishment of co-operatives in all fields of productive enterprise. At present, however, about 85% of the some 400 co-operatives are agricultural marketing and input supply co-operatives in the CAs.

These primary societies are organized into 13 co-operative Unions which act as secondary societies. These Unions play an important role in the wholesaling of inputs, administration of produce marketing carried out by primary societies, local assembly and transport of produce to the Marketing Boards and centralised accounting services.

Since Independence the Co-operative organization has been given the responsibility for the procurement and delivering of inputs for the communal sector. The movement has received considerable donor aid since 1980 to establish a network of 300 input deliveries centers in all the CAs of Zimbabwe.

Inputs destined for the CAs under the post Independence rehabilitation program and subsequently the expanding, Small Farm Credit Scheme and Resettlement Credit Scheme operated by the Agricultural Finance Corporation, are all channelled through this organization.

In addition to the primary co-operative societies a number of small savings clubs have also developed in the CAs. These have grown out of the Savings Development movement and currently there are in excess of 1,200 groups with approximately 60,000 members. They provide a simple and inexpensive saving opportunity and a facility to bulk purchase agricultural inputs for their members.

- b) The Agricultural and Rural Development Authority (ARDA) is a parastatal body set up in 1978 with direct responsibility to MLRRD. The organization was a result of the merger of 3 agencies previously responsible for agricultural development in the then TTLs and commercial farming sectors.

ARDA currently manages some 6,000 ha of irrigation under both estate and settler occupation. In addition, the Government has recently embarked on a state farm program and is in the process of acquiring large, formerly commercial farms, which ARDA will manage as state enterprises.

ARDA also has a vital role as the overall planning and co-ordinating agency for rural development. A National Agricultural and Rural Development Co-ordinating Committee at Permanent Secretary level and involving all relevant ministries is charged with the co-ordination of rural development activities on a nationwide basis.

1.3.2.3 Agricultural Finance Corporation

The AFC is an autonomous parastatal body established in 1971. Its lending policies are determined by the Agricultural Finance Board, the members of which are appointed by MoA. In the past, credit allocations were grossly biased towards the large scale commercial sector. However, since Independence, the AFC has established a Small Farm Credit Scheme, which lends exclusively to communal area farmers and a Resettlement Credit Scheme, for farmers on resettlement schemes. The organization received a US\$ 30.4 million assistance program from IDA for this project. In addition, considerable Government funds (estimated at Z\$32 million for 1984-85) have enabled the AFC to rapidly expand the credit facility available to communal area farmers. (Some 100,000 of these producers will receive credit in the 1984/85 season).

The Commercial Sector has access to a considerable amount of credit from banks and other financial institutions. The inability of communal farmers to use their land holdings as security is often cited as a reason for the failure of these institutions extending the same facility to the CAs.

1.3.2.4 Marketing Organization

The marketing system in Zimbabwe is similar to that established in many countries in Africa. There is a single channel marketing system controlled by statutory bodies buying what are known as "controlled products". These include most of the country's major products.

The method of marketing other commodities vary from regulatory marketing boards for tobacco to entirely free enterprise systems for sugar, tea, pig and poultry products.

a) The Agricultural Marketing Authority

The AMA is in overall control of all the marketing parastatals (with the exception of the Tobacco Marketing Board). It was established in 1967 and charged with the overall administration of the marketing of "controlled products". It makes recommendations to MoA on producer prices and is involved in export promotion.

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b) The Grain Marketing Board

The GMB is responsible for the marketing of maize, wheat, groundnuts, soyabeans, sorghum and coffee. Recently sunflowers and millets have also been included under its activities. The GMB is required by law to buy all controlled crops on offer at prices determined by Government. Its main commodity is maize and it is the sole buyer of this commodity. Commercial farmers are required to sell their maize exclusively to the GMB while CA farmers can sell locally or to GMB approved buyers.

The GMB currently operates over 50 depots in the country. Prior to Independence, the Board had a policy of only siting depots along the line of rail. This generally meant that the depots were a considerable distance from the Communal Areas. Since 1980 a large number of depots have been opened up in the Communal Areas.

c) The Cotton Marketing Board

The CMB is the sole buyer and processor of seed cotton in Zimbabwe. It is responsible for the sale of lint, both locally and internationally. In addition, the board is the sole distributor of delintified cotton planting seed and a

major source of raw material for the domestic oil expressing industry.

The CMB operates some 16 depots, well distributed in all the major cotton growing areas, both commercial and communal. There are currently 8 ginneries in operation and the board is in negotiation for the aquisition of additional ginning capacity under a USA sponsored import program.

The CMB buys seed cotton paying a Government fixed producer price dependent on grade. If, at the end of the marketing period, the Board realises a higher price for the lint, then an additional supplementary payment is made to all producers.

d) The Cold Storage Commission

The CSC is required to purchase all cattle offered to it. In addition, it has also been made responsible for the periodic cattle auctions undertaken in the Communal Areas, where it is required to act as a residual buyer. Producers are not required to sell their cattle to the CSC nor are butchers required to buy exclusively from the Commission. Despite the operation of a parallel private sector market the CSC handles about 85% of all cattle slaughterings.

The CSC operates the necessary plant to slaughter, store and distribute the products. It operates a monopoly on the export of chilled or frozen beef and offals.

e) The Dairy Marketing Board

The DMB purchases all milk and butter fat produced in the country at fixed producers' prices set by Government. It undertakes the processing, manufacturing, distribution and

marketing of milk and milk products. The DMB has a monopoly on the distribution and sale of whole milk in the urban areas of Zimbabwe.

f) The Tobacco Marketing Board

The TMB is owned and controlled by the tobacco growers and the tobacco industry. It does not buy the crop, but is responsible for the licencing of the privately owned floors where the crop is auctioned to local and international buyers. 95% of the crop is flue cured Virginia Tobacco with burley and oriental tobacco comprising the residue.

1.3.2.5 Inputs

The country generally has a good and accessible supply of most farming inputs.

a) Seeds

The Zimbabwe Seed Co-op and other seed companies, through a series of commercial seed growers, produce a number of hybrid maize varieties and other agricultural seeds which are almost universally distributed in the country in a range of convenient package sizes.

b) Fertilizer

Two commercial companies are involved in fertilizer wholesale trade. In addition to a very efficient fertilizer distribution network, the companies also supply a comprehensive agricultural and agronomic advisory service.

Ammonia as a raw material for ammonium nitrate is produced in Zimbabwe, as is phosphate, but the expanding use of fertilizer by communal area farmers since 1980 has resulted in a total demand that exceeds the local production capacity (210,000 t AN as against demand of 280,000 t in 1980/81). Accordingly, nitrogenous fertilizer as well as phosphate are currently imported (as is potassium).

c) Crop Chemicals

Most insecticides and herbicides are imported, but there is a local capacity to formulate dusts and wettable powders.

d) Implements

Zimbabwe has a well diversified manufacturing sector serving agriculture which makes the country not only self-sufficient, but an exporter of most basic farming implements. Currently the commercial farming sector is experiencing difficulties because of foreign currency cuts for tractor spares.

1.3.2.6 Transport

Zimbabwe has an efficient rail network with a significant portion having recently been electrified. The rail network is almost exclusively in the former white commercial area and most CAs are a considerable distance from a railhead. International rail linkages connect to Zambia, Mozambique, Botswana and South Africa.

The country is well served by a good tarmacadam road network and recently a good gravel feeder road network has been planned and is being constructed in the CAs where previously roads were of a very poor standard.

The existing and planned road network will provide a communication infrastructure that should ensure the timely delivery of agricultural inputs and the speedy transport of marketable surplus out of most rural areas.

1.3.3 Pricing Policy

All major crops in Zimbabwe, plus dairy and beef products, are subject to Government price controls. Fixed prices are paid to producers by the statutory marketing boards described in section 1.3.2.4. In addition Government regulates the prices at which the boards sell to food processors and it further controls the retail selling price of all major food items.

Government intervention in agricultural pricing and marketing policy has a long history in Zimbabwe. In the 1930s producer subsidies for maize were introduced to protect local farmers from depressed world market prices. Prior to UDI the Government adopted a policy of guaranteed producer prices for maize to promote self-sufficiency and consumer subsidies to protect consumers from the resultant food price increase.

Immediately after 1965, foreign currency earnings and food security became key elements in Government pricing policy. Producer prices were used to ensure agricultural self-sufficiency and to promote export crops. This policy coupled with a political commitment to maintain low food prices lead to an increasingly large contribution in budgetary terms to agricultural subsidies. As can be seen in Table 16a, large subsidies were supplied in the period 1968-73 for the tobacco industry a vital foreign currency earner. Food subsidies started to increase substantially from 1975.

At Independence producer prices were increased and without substantial and corresponding increases in the consumer prices a huge budgetary contribution was required. In addition to the subsidies contained in the allocation for agriculture, the Ministry of Commerce and Industry provides subsidies direct to millers and oil expressers.

The total food subsidy was more than 4% of the whole budget in 1983/84. The Government has attempted to reduce this subsidy by increasing consumer prices in 1982 and again in 1984 but the high level of the subsidy it inherited and the political impact of rapidly rising consumer subsidies has prevented the Government from making any substantial reduction.

The recent series of three droughts has forced the country to import maize in 1984 and the Government has announced increased producer prices for the 1984/85 crop in the hope of stimulating production in the face of increasing input costs. The Government is experiencing a chronic budget deficit and difficulties in the foreign exchange field and is under pressure from the IMF to remove the subsidies. However, the political impact of this move in the light of next year's general election makes the possibility of a complete removal of subsidies highly unlikely.

The importance of maize in Zimbabwe, and the crop's high production in years of good rainfall, causes important problems for the current pricing policy. Fair producer prices are required to encourage farmers to grow the crop, in the event of a bumper harvest the purchase and storage of the crop can prove to be an extremely costly exercise as it was in 1980/81. The Government is forced to try and balance its producer prices with the possible cost of importing maize. For example, in 1983/84, the maize producer price was kept at Z\$120/t which many claimed was too low to significantly encourage large scale commercial production. A drought in some parts of the country reduced overall yields and because an insufficient area was

planted in the traditional maize producing commercial areas, the country was forced to import over 200,000 t of maize. This maize cost the country between Z\$240 - 310/t, landed in Harare. (Variation in price was dependent on source of contract and port used to import). In the light of this situation, the Government has announced a substantial increase in the producer price to Z\$180/t for the 1984/85 season. This price, below the import price, is a compromise which it is hoped will increase deliveries, but not overburden the marketing organization in the event of a good rainy season.

In addition to the direct subsidies paid to producers, the marketing boards, by paying a standard price at all their depots, subsidise producers in more remote areas. The additional transport costs from these rural depots to the line of rail and main storage facilities are born by the marketing boards. This mechanism ensures some form of equity with large scale producers close to the main depots subsidising producers in more peripheral farming areas.

Currently, the country is a net importer of wheat and the producer price has recently been increased to promote production in an attempt to regain a level of self-sufficiency. Wheat consumption has risen sharply in the last few years and especially in response to consumer resistance to the yellow maize that was imported. The high cost of irrigation development will prevent a significant response from producers to expand production unless the price is further increased but this will necessitate a corresponding jump in the bread price which has become a key staple in both urban and rural areas.

The groundnut price is not high enough to encourage delivery of the crop to the GMB and currently producers can get more than double the official price by selling it through informal channels. This practice is illegal for the commercial producers who are required to sell their crop direct to the GMB and many of them are switching from groundnuts to other more profitable crops.

Dairy products are still heavily subsidized and the low consumer price (despite recent increases) has created a heavy demand for milk products in urban areas. This demand has been met to some extent by the importation of dairy products, some of which have been under an aid program with the EEC.

Cotton producers have continually been paid prices below the world market value of the crop and they have been subject to an implicit tax on this crop. However, the local producer price is still sufficient to encourage expanded production of the crop. A number of commercial growers have moved away from this crop because of the high labor cost involved in picking. Communal areas producers have rapidly become the major producers of this crop and cotton's ability to cope with drought has significantly increased the adoption of this crop by this sector. Some observers claim that the high returns possible with the crop have resulted in its expansion to the detriment of food stable production.

The producer (and where relevant) consumer prices, for the major crops are presented in Table 9 below.

Table 9: Producer and Consumer Prices for Major Commodities in Zimbabwe

Product	Producer Price Z\$ per tonne	Marketing Board Selling Price Z\$ per tonne	Consumer Price
Maize	1980 120 - 104	98	107
	1983 120 - 104	137 - 134	128
	1984 140 - 122	157 - 154	200
	1985 180 -		
Wheat	1983 220 - 210	169 - 163	-
	1984 250 - 240	239 - 230	-
Sorghum	1983 120 - 94	117 - 104	-
	1984 140 - 109	147 - 139	-
Groundnut (shelled)	1983 450 - 318	490 - 350	-
	1984 500 - 353	640 - 460	-
(unshelled)	1983 292 - 207	230	-
	1984 325 - 230	300	-
Soya Beans	1983 273 - 223	193 - 163	-
	1984 301 - 247	362 - 314	-
Sunflower	1983 255 - 208	-	-
	1984 285 - 233	287 - 230	-

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Note: Producer price range given above is for varying grades of the crop concerned.

1.3.4 Past and Present Performance of the Agricultural Sector

1.3.4.1 Resource Base of Commercial and Communal Sub-sectors

Before any consideration of the performance of the two sub-sectors can be made, the extremely biased distribution vis-a-vis Natural Regions, must be given.

Table 10: Distribution of Agricultural Land by Natural Region
(Proportion of Area by Natural Region as Percentage of
Total Area)

Natural Region	Commercial Farming Area	Communal Area
I	3	1
II	27	8
III	22	17
IV	26	45
V	22	29
	100	100

Three quarters (74%) of the CAs lie in Natural Regions IV and V which, as is illustrated in Table 1, is considered unsuitable for viable commercial cropping. Only 48% of the CFA lies in these two regions and most farming units in this area are either ranching or irrigation enterprises.

Over half (52%) of the CFA is in Natural Regions I, II and III, while only a quarter (26%) of the CA lie in these favourable regions.

1.3.4.2 Marketed Output

If the sales of principal crops and livestock are considered, the dominant position of commercial agriculture is shown.

The CFA consistently accounts each year for over 90% of total marketed crops and livestock. In 1984, 40% of maize crop delivered was produced in the CAs, but this is an exceptional case caused by late seasons which favoured these producers and a reduction in the commercial crop because of pricing policy.

The differences in marketable output is naturally reflected in average net income per farm family, over Z\$12,000 for each CFA family as against only Z\$250 per CA family.

Table 11: Summary of Sales of Principal Crops and Livestock in Z\$ million and Giving % of Total

Period	Crops			Livestock				
	From CAs	From CFAs	Total	CFAs Contrib. % of Total	From CAs	From CFAs	Total	CFA Contrib. % of Total
1965	2.3	98.1	100.4	97.7	2.9	25.2	28.1	89.7
1970	2.7	80.9	83.6	96.8	4.5	37.9	42.4	89.4
1975	14.2	224.2	238.4	94.0	7.2	73.2	80.4	91.0
1980	22.0	350.1	372.2	94.1	5.2	115.5	120.7	95.7
1981	63.7	518.2	581.9	89.1	7.6	124.8	132.4	94.3
1982	65.0	484.7	549.6	88.2	8.1	195.1	203.2	96.0
1983	45.6	451.1	496.7	90.8	8.7	209.5	218.2	96.0

Source: CSO Quarterly Digest of Statistics, March 1984.

1.3.4.3 Agricultural Production by Commodity

Table 12 presents the volume and value of crops sold to, or through marketing authorities.

There are some obvious trends in this table, despite the variations caused by the weather. In the pre-UDI period, the total agricultural production was dominated by flue cured tobacco (73%) and both the volumes and contributions of wheat, soya, cotton and coffee were very low. By 1969, the importance of tobacco had been decreased substantially by international sanctions and the process of diversification undertaken by the CFA farmers was beginning to have an effect. Most significant was the spectacular increase in the volume of the wheat crops delivered (from 1930t - 39,000 t). The

TABLE 12: Sales of Agricultural Products to Marketing Authorities for Selected Years
Value in Z\$ million and as % of Total marketed output.

INTAKE YEAR	M A I Z E			G R O U N D N U T S			S O R G H U M			W H E A T			S O Y A B E A N S		
	Volume (t)	Value (Z\$ M)	% of Total	Volume (t)	Value (Z\$ M)	% of Total	Volume (t)	Value (Z\$ M)	% of Total	Volume (t)	Value (Z\$ M)	% of Total	Volume (t)	Value (Z\$ M)	% of Total
1964/65	251483	9.7	10.1	39258	2.7	2.8	3555	0.1	0.1	1931	0.1	0.1	283	0.0	-
1969/70	960107	32.1	33.0	25981	1.9	2.0	11525	0.4	0.4	38938	2.5	2.6	7677	0.5	0.5
1974/75	1336855	52.9	19.9	44416	7.3	2.7	13229	0.5	0.2	90449	7.1	2.7	19053	2.4	0.9
1979/80	511921	30.9	12.0	12714	3.4	1.3	19892	1.5	0.6	158940	18.1	7.0	80999	11.9	4.6
1980/81	819168	72.1	19.2	17425	4.5	1.2	17803	1.7	0.5	163040	22.1	5.9	93636	14.9	4.0
1981/82	2013758	239.8	40.5	20037	5.3	0.9	30393	3.2	0.5	200904	34.7	5.9	65319	11.1	1.9
1982/83	1391265	166.4	30.2	15905	4.4	0.8	19150	2.0	0.4	212945	39.9	7.2	84340	16.8	3.0

TABLE 12: (Cont.)

INTAKE YEAR	C O T T O N			F L U E - C U R E D T O B A C C O			B U R L E Y			S U G A R			C O F F E E			TOTAL VALUE (Z\$ M)
	Volume (t)	Value (Z\$ M)	% of Total	Volume (t)	Value (Z\$ M)	% of Total	Volume (t)	Value (Z\$ M)	% of Total	Volume (t)	Value (Z\$ M)	% of Total	Volume (t)	Value (Z\$ M)	% of Total	
1964/65	6767	1.0	1.0	146891	70.0	72.7	1147	0.6	0.6	-	12.0	12.5	55	0.0	-	96.3
1969/70	160547	21.4	22.1	55973	23.7	24.4	2057	0.8	0.8	-	13.5	13.9	374	0.2	0.3	97.1
1974/75	164722	44.9	16.8	71620	56.1	21.0	3798	2.3	0.9	-	50.3	18.9	2981	2.4	0.9	266.7
1979/80	166830	53.9	20.9	111686	92.0	35.7	2778	2.2	0.9	-	33.5	13.0	4106	10.6	4.1	257.9
1980/81	182037	70.5	18.8	22572	97.4	26.0	2466	2.1	0.6	-	76.6	20.5	5630	12.4	3.3	374.4
1981/82	200812	76.8	13.0	69795	127.5	21.6	2017	3.2	0.5	-	82.4	13.9	4904	7.4	1.3	591.4
1982/83	157673	79.3	14.4	86949	145.8	26.5	3653	6.0	1.1	-	78.0	14.2	6906	12.0	2.2	550.7

Source: CSO Quarterly Digest of Statistics : March 1984.

N.B. Intake year runs from May to April for years prior to 1970/71 and from April to March in subsequent years. This means that the intake year represents deliveries from the previous growing season, i.e. 1969/70 deliveries are the crop produced during the 1968/69 growing season.

other noticeable feature was the rapid expansion in the cotton crop (from 6,800t - 16,000 t) which moved from an almost negligible proportion in 1965 to 22% of the total value of marketable crops in 1970.

These trends continued in 1975 with a more than doubling in the deliveries of wheat and a doubling in the deliveries of soya. The percentage figures for this year are slightly distorted by the second largest maize delivery since the 1940s and the exceptionally high value of the sugar crop. A further feature of this intake year was the volume of groundnuts delivered. In fact, for the 10 years 1967/68 to 76/77 the average annual delivery of groundnuts (unshelled) was nearly 36,000 t.

The period 1979/83 is characterised by a steady increase in the value of the tobacco crop and from 1980 a substantial increase in the value of the sugar crop.

The maize crop delivered during this period experienced large variation because of the weather and other factors. The 1978/79 intake was only 512,000 t as a result of the unfavourable 1977/78 rainy season and the continuing liberation war. The record intake in 1981/82 (in fact 42% heavier than the previous record delivered in 1972/73) was a result of the exceptionally good 1980/81 rainy season, the return of peace after Independence and the extremely favourable producer price. This latter effect is important in explaining the deliveries for the 1982/83 period where, despite a reasonably poor season in 1981/82, there was a substantial delivery. In that year, a situation existed where the producer price was considerably higher than the retail price of maize meal (because of food subsidies).

In the period 1979/83 there was a decline in groundnut deliveries. In fact, the annual average delivery for the six years from 1977/83 was only just over 16,000 t per year.

Wheat deliveries increased over the period, but only by some 34%. Cotton deliveries were reasonably stable with the exception of a record delivery in 1981/82 (again a result of the favourable 1980/81 season). Soya deliveries were also reasonably static, but exhibiting almost a four fold increase over the 1974/75 figures. The lower soya delivery in 1981/82 was a result of competition from the maize crop.

1.3.4.4 Agricultural Exports

Table 13 presents the value of the major agricultural export commodities as well as the total value and its percentage share of total domestic exports.

The major agricultural export of Zimbabwe is tobacco. Despite a decline from 78% of the total agricultural exports in 1965 to about 30% for the years 1975 and 1979 the crop has re-established itself as the dominant export crop since Independence. In fact, in 1983, tobacco represented over 21% of total domestic exports and accounted for nearly half the total agricultural exports.

The value of cotton exports have increased rapidly since 1965 and it is now regularly the second most important export. Sugar also makes a significant contribution to export earnings, although this commodity is the most susceptible to world market price fluctuation.

The maize exports are presented with the actual volume exported. The important, although varied, contribution made by maize to export earnings, is clearly seen. However, the low value, high bulk nature of this crop illustrates its disadvantage as an export crop. For example in 1982 the 348,000 t of maize exported was worth only 20% of the value of tobacco exports which weighed only 75,000 t. Equally,

TABLE 13: Exports - Agricultural and Forestry Products
Value in Z\$ million and as % of Total Agricultural Exports.

YEAR	M	A	I	Z	E	MAIZE SEED		TOBACCO		COTTON		SUGAR		GROUNDNUTS		MALTED BARLEY		TEA	
	Volume (1000 t)	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total
1965	8	0.6	0.5	-	-	89.9	78.0	0.5	0.4	8.3	7.2	0.0	0.0	-	-	0.4	0.3		
1975	842	47.0	20.2	1.1	0.4	71.9	30.9	19.2	8.3	44.3	19.0	1.0	0.4	-	-	3.7	1.6		
1979	219	17.0	6.4	2.4	0.9	85.5	32.2	47.3	17.8	20.6	7.7	1.5	0.6	2.8	1.1	6.9	2.6		
1980	63	7.4	2.5	3.2	1.1	122.9	41.2	58.1	19.5	47.4	15.9	1.3	0.4	2.6	0.9	6.2	2.1		
1981	238	34.7	8.1	2.6	0.6	224.4	52.4	61.2	14.3	54.8	12.8	2.0	0.5	3.5	0.8	5.9	1.4		
1982	348	39.9	10.2	2.3	0.6	194.7	49.7	52.8	13.5	52.3	13.3	2.3	0.6	3.7	0.9	6.1	1.6		
1983	477	47.6	11.2	2.0	0.5	200.0	47.0	66.3	15.6	49.0	11.5	1.1	0.3	4.4	1.0	10.4	2.4		

TABLE 13: (Cont.)

YEAR	COFFEE		MEATS		HIDES		ANIMAL FEEDS		ANIMAL AND VEG. OILS		WOOD		OTHER FOOD PRODUCTS		TOTAL	TOTAL AGRIC. EXPORTS AS % OF TOTAL EXPORTS
	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	% of Total	Value (Z\$ M)	
1965	0.1	0.1	8.5	7.4	2.0	1.7	0.2	0.2	0.6	0.5	n. a.	n. a.	4.2	3.6	115.3	38.9
1975	3.1	1.3	25.6	11.0	2.7	1.2	1.0	0.4	1.1	0.5	2.0	0.9	9.1	3.9	234.6	49.1
1979	10.8	4.1	37.8	14.2	10.1	3.8	7.9	3.0	6.0	2.3	3.1	1.2	6.2	2.3	265.9	41.2
1980	6.4	2.3	18.6	6.2	3.5	1.2	6.8	2.3	2.2	0.7	3.9	1.3	7.4	2.5	298.4	37.9
1981	9.9	2.3	8.5	2.0	2.1	0.5	7.9	1.8	1.1	0.3	4.1	1.0	5.8	1.4	428.5	48.2
1982	14.7	3.8	7.1	1.8	4.0	1.0	1.7	0.4	0.3	0.1	5.0	1.3	4.9	1.3	321.8	48.6
1983	12.0	2.8	16.3	3.8	8.7	2.0	0.9	0.2	0.6	0.1	5.0	1.2	4.0	0.9	425.0	45.5

Source: CSO Quarterly Digest of Statistics : March 1984.

an 110,000 t increase in maize exports between 1981 and 1982 only generated an extra Z\$ 5.2 million in export earnings.

The role Zimbabwe plays in ensuring food security supplies in SADCC will necessitate a continuation of this maize export policy (given suitable weather). However, the transport difficulties facing the region will create a number of problems.

The Government policy since Independence of meeting the expanding local demands for certain food items at the expense of exports is illustrated in the declining export value of such commodities as meat and vegetable oil products.

1.3.4.5 Agricultural Imports

The major agricultural imports of Zimbabwe normally comprise rice, fish and dairy products. Since the late seventies, there has been periodic imports of wheat, but these are not classified separately by the CSO. The values of total food imports are given in Table 14, below.

Table 14: Values of Agricultural and Food Imports into Zimbabwe
1978 - 1983 in Z\$ '000 and as % of Total Imports

Period	Product					As % of Total Value of Imports
	Rice	Fish & Fish Preparations	Milk & Cream	Other	Total	
1978	636	979	145	2888	4648	1.20
1979	1170	801	8	7734	9713	1.80
1980	1803	2179	1082	22938	28022	3.50
1981	1452	1925	1993	9938	15308	1.50
1982	1000	1101	2401	6070	10572	0.90
1983	5000	1300	4500	10563	21363	2.10

Source: CSO Quarterly Digest of Statistics : March 1984

The total food import bill was significantly affected by wheat imports in, for example, 1980 and 1983. But Zimbabwe is not a large food importer by African standards and generally has been a food surplus country.

CHAPTER TWO

THE NATIONAL AGRICULTURAL RESEARCH SYSTEM (NARS)

2.1 Overview

Zimbabwe has an extremely good National Agricultural Research System. There is the necessary infrastructure established to conduct a wide variety of crop and livestock research programs, and, as will be shown in Section 2.3, there has always been a strong financial commitment to agricultural research by the Government.

In the 1950s and 1960s, many would have cited the research set-up in the country as one of the finest in any developing country. The research output was extremely professional and many of the research workers in this country were considered the equal of any of their counterparts in the developed countries. The maize breeding program in Rhodesia was acknowledged as one of the world leaders in this field and a number of research programs in other fields (especially tobacco) could have been considered as important components in the advancement of scientific agricultural research on a world wide basis.

The real strength of the NARS lay in its flexibility and dynamism. With the implementation of international sanctions in 1965 the agricultural industry was forced to rapidly diversify into other crops. This was possible because of the comprehensive support that the NARS could give to this process. The experience gained in the maize breeding program was transferred to crops like wheat and soya. The local expertise in pest management, fertilizer agronomy and weed control enabled the rapid development of viable farmer orientated management systems for these new crops.

Many of the crops presently grown in Zimbabwe have equivalent yields to the leading producers throughout the world. There was, however, a flaw in this impressive system. Like Rhodesia itself, the NARS was largely devoted to one small sector of the population. The settler Governments of Rhodesia had, since 1923, been dominated by farmers. The course of research in the country had been strongly dictated by the white commercial farmers through their direct involvement in Government and through the lobbying of their own organizations. Very little direct research had been undertaken for the majority of farmers, the small scale peasant producers. Most of the crop research undertaken had been in Natural Regions I and II where the majority of large scale producers operated. Any research undertaken in the drier Natural Regions IV and V had been orientated towards extensive cattle ranching or irrigation.

This is not to say that the peasant producers benefit in no way from the agricultural research undertaken. The value of hybrid maize was rapidly realised and hybrids were used by peasant producers. The process of diversification out of tobacco created the need for shorter season maize hybrids (a considerable number of tobacco producers were found on sandy soils in Natural Region III). These hybrids were even more suited to the majority of the CAs and were also rapidly adopted by the small scale producers. Many of the CA farmers in the more favourable agroecological zones also used the fertilizer technology developed essentially for the commercial producers.

Cotton, which became commercially viable in Zimbabwe because of research into pest control and the development of suitable pesticides was also beneficial to the Communal Area farmers. This crop, because of its high labor demand, was ideally suited to peasant producers and its high value made it economically viable for CA farmers despite the high farm to depot transport costs.

During the war period prior to Independence and with the establishment of black majority rule in Zimbabwe, there was substantial white emigration. This process resulted in a considerable loss of experienced research workers. However, the Zimbabwean Government's policy of reconciliation and the absence of any debt settling after a bitterly fought war had the effect of minimising this potential exodus.

Zimbabwe, unlike many less developed countries in Africa, had a wealth of experienced black researchers both inside and outside the country. A number of black Zimbabweans had been gaining invaluable post-graduate education and experience in many countries in Africa and elsewhere and many returned home at Independence.

Thus, today Zimbabwe still has an extremely competent and well staffed research system. Many visitors to this country leave with a strong impression of the depth and potential that exists in the local research organization.

There has been rapid advancement of blacks to senior positions in line with Government directives to "Africanise" the civil service, but in the research organization this impact has been moderated by the number of suitably qualified candidates for this process.

The most important change in the post Independence period for the research organization has been the re-orientation towards the peasant sector. This redirection exercise has been carefully thought out and there has been no sudden discontinuance of research programs that could be considered to be only suitable for the commercial sector. This policy decision and the considerable influx of new staff into the research system has limited the extent to which the backlog of research into the problems of peasant agriculture has been tackled. This new orientation is now clearly integrated into the Government's

policy on research and a considerable amount of new work is being undertaken in this field.

2.1.1 The Structure of the National Agricultural Research System in Zimbabwe

The NARS in Zimbabwe comprises both private and Government funded research organizations. In addition to this clear cut division, there are also private funds contributed by commercial producer associations to the Government's research effort and Government funds allocated to commodity research efforts. This section will simply list the components of the Government research organization which will be covered in more detail in Section 2.2. and fully describe the role of private funded research in Zimbabwe.

a) Government Funded Research

This includes:- Research and Specialist Services. Veterinary research undertaken by the Department of Veterinary Services. Tsetse and Trypanosomiasis Research undertaken by Veterinary Services.

b) Private Funded Research

This includes:- Tobacco Research Board. Agricultural Research Trust. Zimbabwe Sugar Association Research Station. Zimbabwe Seed Companies.

c) Indirect Government Funded Research

University of Zimbabwe.

2.1.1.1 Government Funded Research - Agricultural Research Council

All public sector research is co-ordinated by the Agricultural Research Council (ARC) which serves as an advisory body to the MoA. The ARC is comprised of 12 members including five representatives of the Commercial Farmers Union (CFU), one representative of the small scale farmers, two representatives of the Faculty of Agriculture within the University of Zimbabwe, one representative from the Agricultural and Rural Development Authority and the Directors of the Extension Service, R&SS and the Tobacco Research Board.

The composition of the ARC is indicative of its commercial sector orientation. Various commodity committees are set up under the ARC to monitor research undertaken by R&SS.

From 1976, the ARC performed the function of administering the R&SS research budget but this role was ended in 1982.

a) Private contribution to ARC

The commodity associations of the old Rhodesian National Farmers Union, now the CFU, contributed funds to the ARC for disbursement to R&SS to cover research costs excluding staff salaries.

Table 15: Funds received by ARC from Various Sources in Z\$'000
and as % of Total Income

Year	Government		CFU		Other		Own Re- Sources	Total Income
	Grant Amount	%	Producers Amount	%	Grants Amount	%		
1976	1204	82.9	192	13.2	31	2.1	24	1453
1977	1301	78.9	211	12.8	61	3.7	36	1649
1978	1480	81.6	224	12.3	100	5.3	10	1814
1979	1518	81.0	269	14.3	73	3.9	12	1874
1980	1643	84.2	248	12.7	46	2.4	14	1952
1981	1560	82.3	257	13.6	61	3.2	16	1895
1982	1585	82.5	256	13.3	52	2.7	30	1922

Source: Agricultural Research Council : Annual Reports

Other grants include Coffee Growers Association, Dairy Marketing Board, Cold Storage Commission, Seed Maize Association, Cattle Associations, the African Development Fund (now District Development Fund) and fertilizer companies. Since 1982 there has been some shift in the amount contributed to Government research by commodity associations. The Director of R&SS estimates their contribution now only represents 3% of the R&SS budget.

The CFU and its commodity associations have started investing in an alternative research organization as a form of insurance on continued research effort into commercial problems. For example since 1974 the total contribution of the Commercial Grain Producers Association to the ARC was Z\$850,000, however, since the establishment of the Agricultural Research Trust in 1982 the total contribution by the CGPA to this trust has been Z\$1,500,000.

2.1.1.2 Private Funded Research

a) Agricultural Research Trust

The Agricultural Research Trust (ART) is an independent research, demonstration and training organization supported by commercial farmers and the agricultural trade.

It was formally established in 1982 by the Commercial Oilseeds Producers' Association and the Commercial Grain Producers' Association. It is governed by independent Trustees who interpret the Deed of Trust to "promote agriculture in the widest meaning of the word for the benefit of all people in Zimbabwe".

ART acquired a farm on the outskirts of Harare where some 250 ha are now under cultivation, including some 60 ha under irrigation.

ART is currently run by a Director and the everyday management of the farm is by a farm manager. In addition, research is undertaken by an agronomist and a tillage and mechanisation specialist.

The main research objective of ART is to subject recent research findings to full-scale farm evaluation. This work is intended to adapt research trial information into practical and useable recommendations for farmers. The trust "hopes to bridge the tantalizing gap between research station yields from plots and what the farmer achieves in practice".

The trust is already showing that this can practically be done. The farm achieved wheat and barley yields in 1983 of 7.5 and 7.0 t/ha respectively as against the national average of 3 t/ha for each crop. In this respect, considerable research is being undertaken on aspects of irrigation management covering the timing, quantity and pattern of water application.

Research is undertaken on variety comparison, plant spacing, planting date and depth, herbicide, insecticide and fungicide application.

The importance of land preparation and tillage to the realisation of high yields is the other main aspect of research undertaken and

extensive trials on various methods of minimum tillage are in progress.

In addition to the above, ART allocates some 20% of its resources to local agricultural researchers. These include some projects run by R&SS but the main allocation is to research projects run by the University of Zimbabwe, chemical and seed companies and farm machinery producers. In 1983/84 some 100 demonstrations, trials and formal research projects were completed mainly on plant protection, fertilizer use and crop seed production.

The assets of the Agricultural Research Trust are already impressive. The farm has a book value in excess of Z\$1 million and some \$0.3 million has been spent on irrigation equipment. The planned expansion and operating program envisages an annual budget of \$0.5 million per annum. Currently, the contribution of the 2 commodity producer associations vary with their levy income which is naturally affected by the drought. The oil seed producers have increased their annual contribution from \$0.1 to \$0.2 million while the grain producers contribution has decreased from \$0.35 million in 1982 to \$0.25 million in 1983, to \$0.15 million in 1984.

b) The Tobacco Research Board

The Tobacco Research Board is a statutory body to which complete responsibility for tobacco research in Zimbabwe was delegated by the Tobacco Research Acts of 1936, 1938 and 1950.

The decision to set up the TRB was a result of pressure from the flue-cured tobacco growers in the country, who argued that a more substantial research backing than Government was able to provide through the Ministry of Agriculture was required if the local industry were to expand in the world markets.

The Tobacco Research Board comprises three members representing flue-cured growers, two members representing tobacco buyers, two officers of the Ministry of Agriculture (Directors of R&SS and Agritex) and such additional members as the Board may invite or the MoA may appoint. Traditionally the Board has invited a representative of the air-cured growers as an additional member and further, an independent party knowledgeable in the affairs of the industry, to act as Chairman. The Board is directly responsible to the Ministry of Agriculture.

Kutsaga Research Station near Harare is the headquarters of the TRB and comprises all the laboratories and specialist research departments. It is also the center for flue-cured tobacco research and development. Research, development, extension and training in burley and other air-cured types are centered at the Banket Research Station and in oriental tobacco at the Masvingo Research Station.

The budget for the TRB for the year 1982/83 was \$1,998,739 of which 51% was contributed by the Zimbabwe Tobacco Association (raised in the form of a levy on producers). The Government of Zimbabwe contributed some \$441,000 which represented 32% of the budget, the remaining 17% was generated internally by the sale of tobacco produced on the research stations and the tobacco analysis service.

The Kutsaga station employs 30 professional research staff and numerous technicians, laboratory assistants, etc. The station is larger and much better equipped than the Ministry's Agricultural Research Center and has for many years had a record of excellence in pure and applied research as well as extension.

The research program embraces every aspect of production of the crop and includes the disciplines of engineering, agronomy, soil fertility, physiology, plant breeding and pest and disease control in

the field crop and stored product. It is serviced by a statistics department and an analytical chemistry unit that also serves as a central laboratory for the tobacco trade.

Research findings are disseminated to the grower directly through Agritex, to the commercial sector by the liaison department at the Kutsaga Research Station and by crop specialists on the Banket and Masvingo stations. Development work is carried out by the productivity department which tests research findings on a large, practical scale and also studies the efficient use of resources and maximising economic returns.

The research conducted is extremely sophisticated. Since the 1970s the planting breeding section has been using anther culture technique to raise diploid tobacco plants from the pollen of promising lines, and recently use has been made of protoplasmic and genetic manipulation techniques in the sections continuing breeding work for disease resistance.

One vital aspect of the TRB's work is on the timing of the curing process to ensure that farmers produce the sorts of grades required by international buyers.

c) The Zimbabwe Sugar Association

The Sugar Industry in Zimbabwe runs and funds its own research organization. The Zimbabwe Sugar Association (comprising the major commercial sugar companies) established an experiment station at Chiredzi in 1966 "to investigate problems associated with the production of sugar cane under irrigation in the south eastern lowveld".

The experiment station is independently financed by the sugar industry, with administrative and policy matters being controlled by

a management committee and research matters being directed by a research committee. These committees include executive and technical representatives from the large sugar estates as well as from the private growers. Thus all the work on the station is directly governed by the sugar industry to serve its best interests.

The experiment station comprises 160 ha of land of which about 100 ha are planted to experiments conducted under both furrow and sprinkler irrigation. Well-equipped chemistry, pathology and physiology laboratories and a comprehensive library are available in support of the research program.

The station employs 5 research officers, 30 technicians, recorders and research assistants and some 130 laborers.

The research program covers:-

i) Variety Testing and Evaluation

There is no breeding program undertaken in Zimbabwe. In 1976, an agreement with the South African Sugar Association established a system by which the Natal Experiment Station undertakes a variety breeding program and sends some 25,000 seeds of various varieties to Zimbabwe each year. These new introductions are screened for disease resistance and critically tested for yield potential under lowveld conditions.

ii) Irrigation

A considerable amount of research has been undertaken on the water requirements of the crop. Work continues on comparing irrigation frequencies at different stages of growth and on different soil types, and on evaluating the effects of

pre-harvest drying off schedules. The main objective is to achieve an optimum use of irrigation water.

iii) Fertilizers

The fertilizer research program has served to define optimum plant response to nutrients on the main soil types in the industry, with emphasis on sugar yields rather than cane yield.

iv) Crop Physiology

Studies are being continued to determine the optimum planting and harvesting periods to achieve greater sugar yields.

v) Disease

Considerable research is undertaken on sugar cane smut which is a major disease in the lowveld.

vi) General

Other investigations include studies in weed control, the evaluation of herbicides and the effects of different row spacing and planting systems. The production of ethanol has initiated a number of studies on the total fermentable sugar in the crop and the most economic point to harvest giving the two end products now required by the Sugar Industry.

In addition to basic research, the station provides a number of services which include a regular disease inspection, fertilizer advice, sucrose analysis and general extension.

d) Zimbabwe Seed Co-op

This is a new organization which includes the old Zimbabwe Seed Maize Association (ZSMA). The organization is responsible for the control of hybrid maize production and the distribution of the maize seed on a commercial basis.

Growers are registered and the growing crop is subject to stringent inspections by ZSMA staff.

The Co-op runs its own research station on the Rattray- Arnold farm just outside Harare. Most of the work undertaken is on maize breeding and it is integrated with MoA's maize breeding program. In recent years breeding work on wheat has also been undertaken. In addition, the station is also used to bulk up various seeds which are then grown by foundation seed growers for commercial sale.

2.2 Institutional Structure of the National Agricultural Research System

The main research organization in Zimbabwe is the Department of Research and Specialist Services.

2.2.1 Department of Research and Specialist Services
(R&SS)

R&SS is responsible for Government research in agricultural science and crop and pastoral production. The Department also provides dairy and meat grading services to the agricultural industry. In addition, the department carries out several regulatory functions with respect to animal feeds, fertilizers, seeds and pesticides.

The Department runs the National Herbarium and Botanic Garden and offers an information service providing facilities for the publication of research journals and annual reports plus a scientific information retrieval system.

2.2.1.1 Organizational Structure

The Directorate consists of a director, a deputy director and three assistant directors - one for each of the three research divisions in the department. The directorate is supported by an Executive Branch which is responsible for administration and financial matters.

The three divisions in the department are (a) Crop Research (b) Livestock and Pastures and (c) Research Services. Recently a new Farming Systems Research Unit directly responsible to the deputy director has been established.

a) Crop Research Division

The division comprises:-

1) Cotton Research Institute

This is stationed at Kadoma and is responsible for all aspects of cotton research in the country. It conducts off-station trials in both the high and lowveld. Some of its staff are permanently stationed at the Lowveld Research Station.

2) Horticulture and Coffee Research Institute

This section carries out its work at three Research Stations: the coffee research station at Chipinge; the Horticultural

research center at Grasslands research station and the Rhodes Inyanga experiment station in the Eastern Highlands. The latter station mainly carries out research on deciduous fruit. In addition, a horticulturalist is stationed at the Lowveld research station.

3) Crop Breeding Institute

This institute is stationed at the main headquarters of R&SS, the Agricultural Research Center in Harare. It is involved in the breeding of maize, sorghum, pearl millet, wheat, barley, soyabeans, groundnuts and sunflowers. The institute is responsible for the development of new plant material as well as the multiplication of seed. In addition to the Agricultural Research Center, work is also undertaken at the Gwebi variety testing center, the Rattray-Arnold research farm, the Lowveld research stations and numerous other small testing sites scattered throughout the country.

4) Agronomy Institute

This institute is engaged in research on field crops in the high and midvelds. These crops include the major agricultural crops as well as work on minor crops like beans, cowpeas and cassava. The institute is also responsible for research on weed control and the use of herbicides at the Weed research center at Henderson research station. Crop ecology and crop production research is undertaken at the Grasslands, Matopos and Makoholi research stations and at the Panmure experiment station.

5) Lowveld Research Stations

These include Chiredzi and Chisumbanje research stations (as well as the Sabi Valley station, which was damaged during the liberation war and has not yet been reopened). These stations carry out research for crops grown in the lowveld mainly under irrigation. Recently some research work has been directed towards rainfed cropping in this ecological zone.

b) Livestock and Pastures Division

This division includes:-

1) Matopos Research Station

This station, situated near Bulawayo, is engaged in research on cattle breeding and ranching in medium rainfall areas.

2) Grasslands Research Station

This is situated at Marondera and is engaged in research on improved pastures and pasture legumes as well as research on sheep and beef production systems.

3) Henderson Research Station

This is situated some 30 km from Harare and is engaged in fairly sophisticated research involving reproductive physiology and fertility (including embryo transplants), nutrition for ruminant animals and detailed work on dairy cattle. In addition work is carried out on the introduction and screening of pasture grasses.

4) Makoholi Experiment Station

This station near Masvingo is currently directing its research towards the improvement of the local Mashona breed.

5) Dairy Services Branch

This branch administers the various Government dairy acts and regulations. These include the enforcement of hygienic and product quality standards, the regulation of dairy farms and dairies, and the grading of dairy products such as cheese and butter.

6) Meat Grading Services Branch

This branch is responsible for the grading of cattle, sheep and pig carcasses at all slaughter houses in the country and the grading of live cattle at all communal area cattle sales.

c) Research Services Division

1) Chemistry and Soil Institute

This is located at the Agricultural Research Center in Harare and is responsible for the chemical analysis of soils, plants, irrigation water, agricultural effluents and fertilizers. It provides full soil analysis and fertilizer recommendation service for farmers and undertakes detailed soil survey work in the country.

2) Plant Protection Research Institute

This is also located at the Agricultural Research Center in Harare and is responsible for research into entomology,

nematology and plant pathology. It also provides two regulatory services in phytosanitation and pesticide testing and registration.

3) Agricultural Engineering Institute

This is located just outside Harare at Hatcliffe and is responsible for research on tillage and farm mechanisation. Presently its main research activities are on the design and testing of new farm machinery and implements especially those in the field of minimum tillage, experiments on soil loss and runoff and low cost grain drying methods. In addition, the institute is working on the feasibility of vegetable oils as an alternative or additive to diesel fuel. An Appropriate Technology research unit is working on a variety of alternative low cost technologies in ox and donkey drawn tillage equipment, low cost water pumps and windmills.

4) Biometrics Branch

This is located at the Agricultural Research Center in Harare, and is responsible for the analysis of all data produced in the research organization. It runs and operates a computer service for the department as well as supplying statistical and biometric advice in experiment testing and evaluation.

5) Seed Services Section

This section is responsible for the implementation of the seed certification scheme including the necessary seed crop inspection and testing. It is also responsible for administering the Seeds Act, issuing international seed certificates and protecting the rights of plant breeders under the Plant Breeders Rights Act.

6) National Herbarium and Botanic Garden

These are situated close to the Agricultural Research Center and provide the normal services given by these establishments.

7) Information Services

This section is responsible for the publication and distribution of the annual reports of the various sections as well as the Zimbabwe Agricultural Journal. It provides information retrieval services based on its extensive document collection.

8) Legume Inoculant Factory

This section is responsible for the production and distribution of legume soil inoculants.

2.3 Budget

2.3.1 Allocation to Agriculture

The total budget of the Zimbabwe Government with details of the allocation to Agriculture since 1964-65 is presented in Tables 16a and 16b. The percentage of the budget allocated to Agriculture has decreased substantially since the period 1966/74.

A noticable feature of the allocation to agriculture is the amount included for subsidies, losses and other direct assistance. The total crop, livestock and dairy subsidy has increased from an average for

TABLE 16(a): Analysis of Agricultural Budget Allocations in Zimbabwe, 1964 - 1985 (Z\$ '000)
Details of Total allocation to Agriculture with subsidies and assistance.

YEAR	TOTAL BUDGET ALLOCATION	TOTAL ALLOCATION TO MIN. OF AGRIC	% OF S U B S I D I E S , L O S S E S , A S S I T T A N C E							ALLOCATION TO AGRIC LESS SUBSIDIES			
			TOTAL BUDGET	Crop, Livestock, Dairy Subsidies	Drought Relief	Subsidies Tobacco Corp.	Others	Total	AGRIC SUBSIDIES IN TRADE & COMM ALLOCATION	TOTAL SUBSIDIES AS % OF BUDGET	Total	% of Total Budget	
1964/65	136763	8283	6.1	669				6	675		0.5	7608	5.6
1965/66	152110	11207	7.4	1045	510			1	1556		1.0	9651	6.3
1966/67	163895	17008	10.4	694	920			900	2514		1.5	14494	8.8
1967/68	188382	24646	13.1	3667	330			18	4015	690	2.1	20632	11.0
1968/69	225313	54116	24.0	335	5650	10030		1	16016		7.1	38100	16.9
1969/70	213884	24502	11.5	495	200	9000		220	9915		4.6	14587	6.8
1970/71	238361	41912	17.6	3608	1900	16000		231	21739	1327	9.1	20173	8.5
1971/72	255802	33524	13.1	274	60	19000		356	19690		7.7	13834	5.4
1972/73	366201	42596	11.6	4239		20000		201	24440	2438	6.7	18156	5.0
1973/74	474383	45414	9.6	5750	19800			228	25778	4600	5.4	19636	4.1
1974/75	546872	32522	5.9	12	950	8500			9462	13791	1.7	23059	4.2
1975/76	608092	27697	4.6	5409	50	3150		7	8616	2200	1.4	19081	3.1
1976/77	738157	39721	5.4	18056	50	94		7	18207	3021	2.5	21514	2.9
1977/78	882880	65246	7.4	46520	50			132	46702	2825	5.3	18544	2.1
1978/79	984271	67762	6.9	46722	25			46	46793	3666	4.8	20969	2.1
1979/80	1225934	63628	5.2	29620	25			60	29705	8019	2.4	33923	2.8
1980/81	1627535	66939	4.1	35700	25			16	35741	33000	2.2	31198	1.9
1981/82	2121723	99643	4.7	43608	20			110	43738	79900	2.1	55905	2.6
1982/83	2935560	153836	5.2	74526	30			1354	75910	52000	2.6	77926	2.7
1983/84	3052689	221983	7.3	122518	2239			3014	127771	28000	4.2	94012	3.1
1984/85	3389163	225407	6.7	127676	5			1519	129200	22000	3.8	96207	2.8

TABLE 16(b): Analysis of Agricultural Budget Allocations in Zimbabwe, 1964 - 1985 (Z\$ '000)
Details of allocations to Research, Extension and Veterinary Services and grants for research.

YEAR	TOTAL BUDGET ALLOCATION	RESEARCH ALLOCATION	ALLOCATION TO EXTENSION						ALLOCATION TO VETERINARY SERVICES					
			GRANTS TO RESEARCH		Conex	Devag	Total	% of Total Budget	Veter- inary Research	Tsetse Control	Tsetse Research	Total	% of Total Budget	
			% of Total Budget	ARC										TRB
1964/65	136763	1416	1.0	60	80			2641	1.9	57	829		1747	1.3
1965/66	152110	1517	1.0	60	152			2722	1.8	56	896		1878	1.2
1966/67	163895	1633	1.0	80	155			2980	1.8	53	890		1946	1.2
1967/68	188382	1816	1.0	26	155			3096	1.6	60	955		2060	1.1
1968/69	225313	2082	0.9		155			3376	1.5	63	990		2251	1.0
1969/70	213884	2290	1.1		160	1855				76	1076		2395	1.1
1970/71	238361	2569	1.1		180	1860				92	1130		2541	1.1
1971/72	255802	2860	1.1	15	180	2067				89	1252		2828	1.1
1972/73	366201	3276	0.9	17	191	2198				97	1508		3347	0.9
1973/74	474383	3445	0.7	28	193	2317				101	1889	287	3978	0.8
1974/75	546872	3995	0.7	27	268	2522				111	1576	43	3843	0.7
1975/76	608092	4231	0.7	1281	287	2819				123	2167	83	4663	0.8
1976/77	738157	4629	0.6	1419	319	3119				145	2194	36	5575	0.8
1977/78	882880	4775	0.5	1480	330	3089				150	1702	33	4539	0.5
1978/79	984271	5478	0.6	1519	435	3645	4992	8637	0.9	160	1689	36	5736	0.6
1979/80	1225934	6053	0.5	1619	470	3671	6565	10236	0.8	197	1674	36	6327	0.5
1980/81	1627535	8074	0.5	1512	545	4270	8323	12593	0.8	205	2779	36	7958	0.5
1981/82	2121723	7731	0.4	1585	572			15307	0.7	315	4899	30	19551	0.9
1982/83	2935560	8246	0.3	1915	640			14705	0.5	400	5925	49	22444	0.8
1983/84	3052689	9198	0.3	2078	729			17302	0.6	520	6315	76	23597	0.8
1984/85	3389163	10852	0.3	2840	802			19988	0.6	620	6093	79	22899	0.7

the 5 years 1964/69 of \$1.3 million per annum to \$61.2 million per annum for the 5 year period 1979/84. As these subsidies are used largely to keep the consumer prices of agricultural products low for the urban population, it is more meaningful to exclude them from the analysis in Table 17 below. The allocation, less these consumer subsidies, is a better reflection of the government's actual commitment to rural Agriculture.

Table 17 : Average Budget Allocation to Agriculture (less subsidies, losses and assistances) as a percentage of total budget for various periods.

Period	Agric. Budget (less subsidies) as % of Total Budget
1964/69	10.4
1969/74	5.6
1974/79	2.7
1979/84	2.7

The effective allocation to agriculture has declined since the mid 60's. Despite an encouraging rise in the percentage allocated in the 1983/84 budget, the total allocation is extremely small considering the relative importance of the sector to total GDP, exports and employment.

2.3.2 Allocations to Research

The total budget allocation for research is difficult to separate out from the overall budget. The allocations to R&SS must be examined in the light of a number of factors. Firstly, they do not represent the total Government allocation to agricultural related research.

Allocations to the TRB and expenditure on veterinary and tsetse research are not included, but as these components are relatively small, and an analysis of the R&SS budget will be generally indicative of the Government's budgetary commitment to agricultural research (excluding tobacco).

Secondly, in the period under study, the R&SS budget has, up to 1981/82, included the allocation for agricultural education. These funds have covered the staff salaries and operating costs of a number of agricultural colleges and schools. The budgets for 1965/66 and 1966/67 enabled this component to be identified, it represented 15.7% and 15.5% of the allocation to R&SS. Subsequent to this, the separation is impossible. However, a World Bank staff appraisal report for the National Agricultural Extension and Research Projects, report that the allocation to R&SS in 1980/81 included some 6.5% for agricultural education.

Given these limitations, Table 18 below presents an analysis of the allocation to R&SS in terms of a percentage of total agricultural and forestry GDP, as percentage of the agricultural budget (less subsidies, losses and assistance) and as percentage of the total budget.

Table 18: Allocation to R&SS in relation to Agricultural GDP, Total Budget and Agricultural Budget less Subsidies

Year	As % of Agric & Forestry GDP	As % of Agric Budget (less sub- sidies, losses and assistance)	As % of Total Budget
1964/65	1.14	18.6	1.04
1968/69	1.11	5.5	0.92
1973/74	1.09	17.5	0.73
1978/79	1.66	26.1	0.56
1979/80	1.30	17.8	0.49
1980/81	1.28	25.9	0.50
1981/82	1.15	13.8	0.36
1982/83	n.a.	10.6	0.28
1983/84	n.a.	9.8	0.30

Government's expenditure on agricultural research (excluding tobacco) has generally remained over 1% of the agricultural domestic product during the period studied. It is lower than the World Bank's 1990 target of 2%, but has generally been well above the recommended level of 1%. It is certainly a lot higher than most countries in Africa. In 1980, the percentage equivalent of agricultural GDP committed to agricultural research in Zimbabwe was over twice the average figure for countries in Sub-Saharan Africa (ISNAR/IFPRI 1981).

A persistent problem in the research systems of developing countries has been the insufficient allocation for operational expenditure in research. The R&SS budget for 1980 was subject to the following analysis in an attempt to show the percentage of the budget allocated to wages and salaries versus specific recurrent expenditure and capital development.

Table 19: Breakdown of R&SS Budget for 1980/81

	Z\$'000	% of R&SS Allocation
Agricultural Education	525	6.5
Salaries and Wages	5,752	71.2
Research Expenditure	1,796	22.3

The figures in Table 19 clearly indicate that Zimbabwe suffers from a high salary and wages component in its allocation to research. The problems this can cause are highlighted in the following quote (ISNAR/IFPRI, 1981).

"For a number of those (countries) where it is recorded, the bulk of recurrent expenditure seems to be for salaries In several cases, little remains for operations, implying both a high degree of inefficiency in the use of the scarce resource of trained scientists, and a high level of frustration among those scientists keen to do a good job."

This frustration is often reflected in the resignation of scientists from the national agricultural research system. Although Zimbabwe is obviously not as bad as some countries, the rapid increase in the salary component of the research allocation is a worrying trend which should be closely monitored.

A further breakdown of research expenditure among the major divisions of R&SS is presented below in Table 20 and shows the percentage of the budget (excluding salaries) allocated to each section for development and operating expenses.

Table 20: Research Expenditures (Excluding Wages and Salaries) in R&SS for the Financial Year 1980/81 in Z\$.

	Amount Z\$	%
Administration	51,529	2.9
Development Expenses		
Crops	65,661	3.7
Livestock and Pastures	42,647	2.4
Research Services	21,365	1.2
Sub Total	129,673	7.2
Operating Expenses		
Crops	533,682	29.7
Livestock and Pasture	642,440	35.8
Research Services	222,417	12.4
Sub Total	1,398,545	77.9
Other Expenditure		
Agricultural Engineering Institute	143,056	8.0
Provision for Incomplete Research	70,238	3.9
Grants Disbursed	3,300	0.2
GRAND TOTAL	1,796,341	100.0

These figures show that R&SS is not the victim of further mis-allocation of resources as experienced by a number of other countries. The majority of the residual budget (excluding wages and salaries) is allocated to operating expenses. The percentage allocated for administrative support is low and the small percentage allocated for capital development is indicative of the good infrastructural development that has already been achieved in Zimbabwe's research organization.

Of more interest is the allocation to the various divisions of R&SS. The allocations to various commodities are impossible to separate and the allocations to those different divisions are the only indication available of the priorities used in resource allocation. Nearly half (46%) of the total operating expenses goes to Livestock and Pastures. The research undertaken by this division is almost completely orientated towards large scale commercial ranching. Much of the research involves exotic breeds and research on pasture management and improvement is undertaken under conditions such as rotational grazing in fenced paddocks, which are currently difficult to implement in CAs because of the communal grazing arrangements.

Only 38% of the operating costs go to support research on all the crops studied in Zimbabwe. It is fairly obvious from the history of research in Zimbabwe that there was very little research devoted to the Communal Areas of Zimbabwe until Independence. Most of the allocated research budget has, in the past, been largely for the benefit of the commercial producers.

The new direction at R&SS towards adaptive research orientated towards the problems being faced by communal producers, especially in Natural Regions IV and V is encouraging, but the importance of the commercial sector has moderated the Government's ability to rapidly change the relative budget allocations between the two sub-sectors.

2.4 Staff

An analysis of staff levels from 1960 is extremely difficult, as up to 1963 the country's National Research System was part of the Federation of Rhodesia and Nyasaland. Table 21 presents the staffing levels of research and experimental officers in the three major divisions of Research and Specialist Services between 1970 and 1984.

Table 21: Employment and Vacancies of Experimental and Research Officers 1970 - 1984

	1970		1974		1977		1984	
	Act- ual	Vac- ant	Act- ual	Vac- ant	Act- ual	Vac- ant	Act- ual	Vac- ant
<u>Directorate</u>	4	0	4	0	4	-	5	0
<u>Crop Res. Div</u>								
Agronomy I.	5	1	10	0	7	-	7	1
Cotton R.I.	7	1	10	1	6	-	8	2
Crop Breed. I.	6	4	8	2	10	-	9	0
Horticulture R.C	0	0	2	0	2	-	2	1
Coffee R.S.	2	1	3	0	1	-	2	1
Rhodes/Inyanga E.S.	2	0	1	0	1	-	2	0
Lowveld R.S.	7	1	7	1	4	-	5	2
Sub Total	29	8	41	4	31	-	35	7
<u>Livestock & Pastures Div.</u>								
Grassland R.S.	6	1	4	0	4	-	7	2
Henderson R.S.	8	0	11	0	12	-	12	2
Matopos R.S.	4	4	7	0	7	-	9	2
Makoholi E.S.	2	0	1	0	1	-	2	1
Dairy Services	2	4	4	1	3	-	7	0
Sub Total	22	9	26	1	27	-	37	7
<u>Research Services Division</u>								
Plant Protection RI	13	3	14	1	14	-	14	3
Chem. & Soils R.I.	19	6	20	3	16	-	24	4
Biometrics								
Bureau	4	2	4	2	4	-	7	0
Herbarium & Botanic Gardens	4	1	5	0	6	-	4	1
Seed Services	3	0	2	0	3	-	6	3
Information Services	0	0	2	1	3	-	1	1
Sub Total	43	12	47	6	46	-	56	12
FSR Teams	0	0	0	0	0	-	4	1
TOTALS	98	29	118	12	108	-	137	27
TOTAL Est.	127		130		-		164	

Source: ISNAR : Manpower Training Plan for R&SS 1984

Table 22: The Combined Officers and Technicians in the
Three Divisions Showing % of Distribution of Staff

	1970	%	1974	%	1977	%	1984	%
Crop Research	57	29.9	84	36.7	71	33.2	69	32.2
Livestock and Pastures	61	31.0	63	27.5	63	29.4	63	29.4
Research Services	79	40.1	82	35.8	80	37.4	82	38.3
	197	100.0	229	100.0	214	100.0	214	100.0

Source: ISNAR: Manpower Training Plan for R&SS 1984

The allocation of staff between the three divisions has remained fairly static over the period studied.

This staff distribution again shows the bias towards livestock and pasture research and illustrates that Research Services has a larger staff allocation than the Crop Research Division.

The growth in the establishment of research and experimental officers between 1970 and 1984 is 0.6% per annum which would indicate that the expansion of the numbers of scientists is well below the rate of growth in agricultural GDP, for the same period.

If in 1984 the same percentage of the R&SS budget was allocated to research expenditure as it was in 1980, (see Table 19), this would represent \$2.05 million and would be equivalent to Z\$12,500 per scientist. If the whole R&SS budget is considered, then the allocation is Z\$56,000 per scientist (which would represent approximately US\$41,000 per scientist).

This figure is, however, considerably below the average for middle income countries in Sub-Saharan Africa, US\$60,000 in constant 1975 prices (ISNAR/IFPRI, 1981).

A number of other key issues are also raised in the ISNAR/IFPRI report and these will be considered briefly.

2.4.1 Technical Support for Scientists

The report indicates that where scientists are not adequately supported by trained assistants, their research work suffers because they are forced to divert their attention to other less important duties. The ratio of technicians:scientists is given below in Table 23.

Table 23: Ratio of Technicians : Scientists in R&SS in Selected Years for the Major Divisions and for the Whole Organization.

	Crops	Livestock & Pastures	Research Services	Total R&SS
1970	0.96	1.77	0.84	1.05
1974	1.05	1.42	0.75	0.97
1977	1.29	1.33	0.74	1.02
1984	0.97	0.70	0.46	0.63

Source: Calculated from ISNAR Manpower Study for R&SS.

The figures show that except for 1984, the NARS normally achieved a ratio close to 1:1. The low figures in 1984 are caused by the rapid increase in scientists between 1977 and 1984 (from 108 to 137) and the high number of vacancies in the technician grade (20% of posts were vacant in 1984).

2.4.2 Level of Experience in R&SS

The staff loss in R&SS since 1980 and the large number of new research officers recruited has resulted in a relatively inexperienced staff. Only 13% of the total scientists have 11 or more years experience. The situation in the various divisions is given below.

Crops Research Division - 48.4% have 2 years or less experience and 71% have 5 years or less experience.

Livestock and Pastures Division - 51.4% have 2 years or less experience and 68.5% have 5 years or less experience.

Research Services - 46.8% have 2 years or less experience and 78.7% have 5 years or less experience.

2.4.3 Dependency on Expatriates

In some developing countries, the number of foreign scientists is often cited as an element of weakness in the NARS. These scientists are often on short term expatriate contracts resulting in a lack of continuity in research. Zimbabwe has not been a victim of this phenomena. In fact, in 1980, there were no expatriates and by 1984 ISNAR reported that only 14% of the scientists in the NARS were foreigners. Most of these personnel are employed on a short term basis and most are being understudied by local scientists. R&SS plans to phase out this expatriate staff over the next few years.

2.5 External Influence in NARS

The following is a list of major sources of external assistance currently being received by R&SS.

2.5.1 National Agricultural Extension and Research Project

This is co-funded by IFAD and the World Bank (IBRD) under a loan agreement. The overall aim of the project is to build the agricultural extension and research capacity needed to substantially increase agricultural production and farm incomes in the communal areas while enabling the commercial agricultural sub-sector to maintain and improve its performance. The implementation period was meant to be 1983/84 - 1986/87 but full implementation has been delayed by administrative difficulties. US\$ 10.9 million of the US\$31.1 million project loan has been allocated to R&SS to:

- strengthen administrative and accounting structure,
- eliminate the housing, equipment, and transport backlog in order to restore capacity in plant breeding, cotton and agronomy research,
- expand research activities in Natural Regions III, IV and V,
- strengthen training capacity in R&SS,
- provide technical assistance in key areas.

2.5.2 The International Development and Research Center

IDRC of Canada is supporting two projects. A three year sorghum and millet breeding program costing \$322,000 and a farming systems research project with a total budget of \$327,000, to be run in collaboration with ILCA and CIMMYT.

2.5.3 The Overseas Development Administration

The ODA of the British Government is supporting three projects - the Matopos goat research unit, Henderson dairy unit and the Sabi Valley research station. In addition, staff will be supplied for the Cotton Research Institute, Chemistry and Soil Science Institute and the Biometrics Branch. Total funding is in excess of £0.5 million.

2.5.4 The United States Agency for International Development

USAID has offered to assist R&SS in the training of personnel under the African Manpower Development and Science and Technology Assistance Programs. US\$45 million is allocated under the Zimbabwe Agricultural Sector Assistance Program (ZASA) but R&SS has not yet drawn on these funds.

CHAPTER THREE

IMPACT OF THE INTERNATIONAL AGRICULTURAL RESEARCH SYSTEM ON THE NATIONAL AGRICULTURAL RESEARCH SYSTEM IN ZIMBABWE

3.1 General Issues

The measurement of impact (as described in Section 1.1) is difficult because of a number of complementary factors which react in a sympathetic or antagonistic fashion on the intended effect of any intervention. A new crop may not be adopted because of an inadequate producer price, or it may fail to give the necessary yield increases because of a lack of necessary inputs. This background noise makes it difficult to determine the real impact of any innovation.

The isolation of Zimbabwe during the UDI years reduced the number of IARCs that interacted with the NARS. Since Independence, most of the international centers have become involved in Zimbabwe but as yet there are very few tangible results which could be subject to an evaluation let alone an assessment of impact.

The strength and efficiency of the NARS is possibly the biggest single factor that predetermines if the input of an IARC has any effect. An IARC can release new varieties to a NARS, but if the personnel to field test the material and bulk it up for distribution are not there then very little will happen. This is not the case in Zimbabwe. The NARS is reasonably strong and has an exceptionally good track record of useful and significant agricultural research. In this situation, the very strength of the NARS will result in an even greater potential impact by the IARC, if the input being provided is complementary to the country's research efforts and priorities.

Given the isolation that Zimbabwe experienced from many of the IARCs and the obvious strength of the NARS, one is forced to consider the possibility that national research efforts can develop without any IARC involvement. Zimbabwe is a classic example, in some fields of research, of how adequately a research system can function without the international network of research centers. If this is the case, then one is left with an even more difficult situation in the measurement of impact, attempting to predict the "without case".

3.2 Biological Material

The provision of biological material is one of the main functions of many of the IARCs. In this section, the transfer of biological material to the NARS of Zimbabwe is reviewed.

Table 24: List of Biological Material Supplied to the National Agricultural System in Zimbabwe by IARCs

Organization

CIMMYT	- Wheat varieties
	- Maize varieties
ICRISAT	- Sorghum & Millet varieties
	- Groundnut varieties
IITA	- Cowpeas
	- Pidgeon peas
	- Maize
	- Cassava
	- Sweet Potatoes
	- Rice
CIAT	- Beans
CIP	- Potato varieties

The list of material above has been gathered from the responses of those interviewed and could be incomplete because of a failure to interview all researchers who may have received material. However, the purpose of this section is not to provide an exhaustive check list of all the genetic material supplied by IARCs but to attempt to illustrate key issues in this field.

The first part of this section deals with the beneficial impacts that the transfer of biological material to Zimbabwe has had. The latter sections cover what respondents report as inadequacies or problems they have encountered with biological material supplied by the IARCs.

3.2.1 Wheat Varieties

CIMMYT has been supplying wheat varieties to this country's wheat breeding program from the 1960s. The flow of material from this international center was uninterrupted by UDI and this IARC is really the only one which can legitimately claim to have made a significant contribution to agriculture in Zimbabwe.

Section 1.3.4.3 details the spectacular increase in wheat production and the subsequent decrease in wheat imports that occurred between 1964 and the present day.

The development of dwarf and semi-dwarf wheat varieties has played a vital role in the rapid attainment of self-sufficiency in wheat production. The difficulty is in trying to isolate the component contribution the CIMMYT wheat varieties have made to this process. All the wheat in this country is grown under irrigation by either large scale commercial farmers (95%) or ARDA estates (5%). Yields are exceptionally stable and among the highest average yield per ha in the world at around 4.5 t/ha. (Commission of Inquiry into Agricultural Industry, 1982).

For this level of production to be achieved, a number of complementary factors related to the large scale investment required could be considered more vital than the biological material used.

The Government stimulated interest in wheat growing after 1965 by establishing high producer prices well above import parity and by providing long term low interest loans for producers prepared to invest in irrigation development.

Despite this infrastructural and marketing support, the role of the varieties must still be considered very important. The sustained production of the crop is also dependent on continued research and the constant development of new varieties. The threat of rust limits the use of each variety to a period of 3-5 years.

A detailed evaluation of the historic role played by CIMMYT genetic material in Zimbabwe's wheat variety is extremely difficult and is, in fact, a complement to the manner in which this organization interacts with NARS in the supply of biological material. The national wheat breeders are allowed to use CIMMYT material in their program and any released variety is named by the local breeders. The exact nature of the CIMMYT parentage is therefore hidden in the minutes of R&SS Crop Variety Release Committee. This unrestricted provision of material and the process by which the national breeding program is allowed to take the credit for the new variety is an excellent example of an IARC making a useful contribution to the development of a NARS.

The fact that CIMMYT in Mexico is at the same latitude north as Zimbabwe is south, has removed the complication of having to alter varieties for different day lengths.

The first dwarf variety of wheat released in this country was Tokwe, which was developed locally by the wheat breeder Ollson from South African material.

A later variety which was extremely popular was Limpopo, which had some small portion of CIMMYT material in it. This variety has now lost popularity and has been replaced by a number of newer varieties released since 1978. These are presented below and their parentage is also given.

Table 25: Parentage of Zimbabwean Wheat Varieties

Variety	Year Released	Parentage
Gwebi	1979	Straight CIMMYT variety Yecora 70.
Angwa	1980	Cross between CIMMYT variety Cajeme and Corre Caminos.
Sanyati	1981	Local material crossed with CIMMYTs Saric 70 of the Bluebell series.
Chiwore	1982	Originates from a CIMMYT cross involving a number of parents including Asteca 67 and Yecora S.
Umi	1983	Mainly local varieties with some CIMMYT material of the Torim 73 series.
Lesape	1983	A CIMMYT cross involving Kavkas/Buhos/Kalyansona/Bluebird. This material has a Vire background as it is a spring x winter x spring backcross.

Source : Crop Breeding Institute, R&SS internal documents and annual reports.

The superiority of the CIMMYT material is illustrated by the fact that both Sanyati and Umi varieties have had to be withdrawn because of rust problems.

In addition to the material listed above, a direct CIMMYT variety TORIM 73 was released in Zimbabwe under its own name.

Table 26 below presents the experiment yield data for a number of the wheat varieties discussed above.

For the 1984 growing season, the major varieties of wheat planted have been determined from estimates of the Commercial Grain Producers' Association. Gwebi and Torim 73 comprised 60% of the wheat planted while 25% was the variety Angwa. Limpopo and Tokwe still represent about 10% of the crop (mainly in the Lowveld). Chiwore and Lesape comprise the remaining 5%.

There was a problem of seed shortage of the varieties Angwa, Chiwore and Lesape and it is expected that these varieties will expand at the expense of Limpopo and Gwebi. A commercial seed company is currently marketing a CIMMYT variety under the name of Yecora, and the availability of this seed should result in an increase in this variety during next winter's crop.

Table 26: Wheat variety, experimental plot yield in kg/ha
expressed as a percentage of Tokwe Yield 1978/80.

Variety	Highveld	Lowveld
Sanyati	8729 (109)	6038 (107)
Chiwore	8588 (107)	6380 (113)
Gwebi	8492 (106)	6268 (111)
Limpopo	7893 (98)	5650 (100)
Tokwe	8033	5622
Torim	8213 (102)	6158 (110)
Angwa	8218 (102)	6119 (109)

Source: Crop Breeding Institute, R&SS Annual
Report, 1981

This table, while showing the importance of CIMMYT wheat varieties illustrates quite clearly that in Zimbabwe, one is not discussing yield increases of the order of 3 to 4 times but a modest 5 - 10%.

However, the importance of new material in sustaining yields should not be underestimated. Wheat consumption in Zimbabwe continues to expand in line with trends in other developing countries, and the importance of wheat self-sufficiency given the country's foreign currency shortage is extremely valuable.

Currently in Zimbabwe, wheat consumption is again exceeding production. Despite the availability of good varieties, production will only be increased if the Government again adopts bold policy measures in terms of attractive pricing and investment support for producers with irrigation potential and the management ability to grow wheat. The series of droughts that the county has recently experienced also underscores the need for improved management and exploitation of available water resources in the country.

3.2.2 New Crops

The re-orientation of the NARS towards the problems of small rural producers since Independence has been a significant change in policy. A policy shift of this nature in a self-contained agricultural research system would require a considerable amount of time to produce any releasable biological material. Breeding programs would have to be established and material collected, characterised and crossed before even field testing could begin.

Zimbabwe's new direction in its research objectives has been the single biggest beneficiary of biological material supplied by the IARCs. New crops suited to peasant production are now receiving the attention of the NARS. With the variety of material available from the IARCs, the country has been able to rapidly select from a range of elite biological material, test and evaluate it under local conditions and very rapidly reach the stage where new varieties could be released to farmers.

a) Cowpeas

The Shona in Zimbabwe have, for generations, grown cowpeas, which are called locally, "nyemba". The varieties grown in this country are generally short crawling types grown by women in their household gardens. The leaves are picked to make a vegetable relish to go with the main staple, maize, sorghum or millet meal, made into a stiff porridge, "sadza".

The cowpeas are collected and made into a thick bean soup called "rupidza". The local varieties are not heavy yielders and the grain is relatively small. This dish is therefore considered a great delicacy and is very rarely served. The changing patterns of production in the Communal Areas has resulted in diminished gardening activities as women have been forced to contribute more of their labor towards the production of field crops. This change in labor allocation has been a result of many factors, the major ones being the high degree of male labor migration from rural areas and the adoption of more labor demanding crops like cotton and hybrid maize (the maize hybrids are more susceptible to weed competition than local varieties and other small grains).

The availability of a large range of cowpea material from IITA has enabled the Agronomy Institute of R&SS to rapidly establish a research program on this crop. This has been achieved without a local breeding program and the continuing research effort at IITA should result in a constant supply of new varieties, removing the need for R&SS to establish a national breeding program.

In 1981, IITA supplied a complete range of improved cowpeas, which were research station tested and selected during the 1981/82 season. Promising varieties were field tested in the 1982/83 season and during the 1983/84 season selected varieties were grown at a number of sites in the communal areas under the CART program (Communal Area

Research Trials) where the material has been tested under farmers' conditions. The varieties are now ready to be released by R&SS to allow for their bulking up and distribution.

The varieties selected by the NARS are part of IITA's exciting new 60 day varieties. These varieties have achieved yield under CART of about 1t/ha at rainfall levels as low as 200 mm during last season's drought. Other promising varieties being tested are IITAs bruchid resistant strains (these insects are a common storage pest in cowpeas).

b) Cassava

Cassava is not eaten universally in Zimbabwe. Peoples from Mozambique who have infiltrated the eastern border area have introduced the crop and the large number of migrants from Malawi and Mozambique have brought this crop to the large scale commercial areas where they work as farm laborers.

The department of R&SS has not devoted a substantial emphasis to this crop but has started agronomic trials on varieties supplied by IITA. In addition, the Crop Science Department at the University of Zimbabwe has also started a cassava research program.

As with cowpeas, the provision of an excellent range of material has enabled the NARS to forego the necessity of a breeding program.

c) Sweet Potatoes

As with the previous crops, sweet potatoes are being subject to agronomic trials with material supplied by IITA.

3.2.3 Existing Crops

a) Maize

Zimbabwe's maize program is extremely advanced, and is now backcrossing elite inbred lines onto streak virus resistant sources from IITA. This program, based on IITA'S TZSR variety may prove to be useful. IITA's maize program is more compatible with the local maize program than CIMMYT's maize program because the center, like the NARS, has concentrated its efforts on hybrids.

b) Groundnuts

Zimbabwe has also had an extremely advanced groundnut research program in the past, which was highly geared towards commercial production with considerable breeding work done on varieties suitable for production under irrigation. The country has achieved a tremendous amount of success in high input commercial production, recording world record yields of 9 t/ha.

Groundnuts are in fact one of the most important crops in the Communal Areas, but very little research has been undertaken on problems facing peasant production.

ICRISAT has a regional grain legume center in Malawi and both R&SS and the University of Zimbabwe are receiving material as part of the regional testing program and collaborating on research into Rosette Virus disease (transmitted by aphids) which is the major disease of the crop in the CAs.

c) Soya beans

The country has an equally advanced breeding program on this crop and there have been exchanges of material with IITA. It is felt, however, that this exchange has benefited the IARC more than the NARS.

d) Field Beans

The research program on field beans has benefited from new varieties obtained from CIAT.

3.2.4 Difficulties and Problems Encountered by the NARS in the Transfer of Biological Material from the IARCs

This section highlights, with examples, a few of the specific comments that personnel in the NARS have made during the interviews for the impact study.

a) Available material inappropriate to breeding program

i) Maize

Zimbabwe's maize breeding program started in 1930 and has achieved world wide recognition. After seventeen years of research (in 1949) the first hybrid, SR1 was released to farmers. This made Southern Rhodesia the first country after the United States to produce hybrid maize commercially. The most significant achievement was the release in 1960 of the 150-day hybrid SR52. This hybrid has, as its parents, two locally bred varieties - Southern Cross and Salisbury White. To quote Prof. Carl Eicher (1984):-
"SR52 is undoubtedly the Green Revolution success story in Southern Africa".

This variety has been largely responsible for the spectacular maize yields achieved in Zimbabwe over the past 24 years.

Subsequently the earlier maturing hybrids (130 days) were released in Zimbabwe in the 70s. These hybrids (R299, R200 and R215) basically have, as their parent, an American (Kansas) variety K64R, which was imported into South Africa because of its leaf blight resistance.

The CIMMYT maize breeding program has tended to concentrate on open-pollinated varieties and to select for wide regional adaptability. The center does not have a program that caters for the conditions found on the Highveld in Zimbabwe. For this reason, much of CIMMYT's material has been inappropriate for the national maize breeding program.

Some material from the center's high protein (lysine) program is being retained as background breeding material, the problem with these varieties is that the high lysine gene is associated with a soft kernel and the material will have to be heavily modified to be useful. In 1979 CIMMYT responded to this problem by supplying certain opaque 2 populations with a modified hard endosperm phenotype. However, increasing the yields to acceptable levels will be an extremely long term program for which the department lacks adequate resources.

ii) Sorghum

Zimbabwe has had its own sorghum breeding program for a number of years. The program has concentrated on high yield, short season, red sorghum varieties suitable for brewing. This very specific and narrow breeding objective

has meant that most of the material available from ICRISAT has been largely unsuitable as it tends to be white and in local tests does not match the yield achieved by the local standards.

b) Material Unsuitable to Local Consumer Preferences

i) Potato Material from CIP

Zimbabwe has had, for a number of years, a very efficient and advanced potato breeding program. The country is self sufficient in seed potatoes and has made no seed imports for over 20 years. There is an established and viable virus testing program. Most new varieties have been imported as 3 tuber samples and after testing and local adaptation, bulked up and released.

The main objectives of the breeding program have been to obtain varieties with high yields, blight resistance and suitable ware characteristics.

The country has about 3000 ha of this crop grown each year, most of it by commercial growers using high fertilizer inputs and irrigation. Average yields are about 17 t/ha. The growers are concentrated near the main centers and produce almost exclusively for the urban market. Seed producers tend to be concentrated in the eastern highlands. This market has developed a preference for smooth-skinned, regular shaped, white fleshed potatoes.

CIP provided true potato seed from its Peru headquarters in 1975, but no suitable types were found among the varieties. Most were rejected on the basis of flesh color and tuber shape. The isolation of Rhodesia prevented contact with

CIP's regional office in Kenya until after Independence. In 1981 material was obtained from Kenya. This was planted out, bulked up and subject to observation trials. Again, most of the material was unsuitable on the basis of the breeding program's objectives. However, four of these CIP varieties have been identified as useful future breeding material and these have now been transferred to the collection maintained at the Rhodes-Inyanga research station, which is grown out every year. These varieties, despite the unsuitability of their shape, have been retained because of their reported resistance to late blight. The incidence of this disease has been very low over the last three years and this has prevented any evaluation of this resistance under local conditions.

The breeder in Zimbabwe is extremely experienced having been in charge of the program since 1969. He is also enlightened enough to realize that current potato production and consumption patterns may change in Zimbabwe and that at some future date there may be a place for potato varieties without a suitable peeling shape, but which grows well without heavy fertilizer inputs and the requirement for periodic fungicide sprays to control blight. He points out, however, that if such a potato was identified, the current system of having commercial seed producers may make the seed produced too expensive for the intended clientele - the small scale producer growing for home consumption and the informal market.

ii) Sweet Potato Varieties from IITA

At the Lowveld Research Station, the horticulturalist is evaluating sweet potato varieties from IITA. In 1981 he received seed from IITA, which came from 5 general parents

and comprised 67 lines. These have been evaluated since the 1981/82 season. Initially, over 30 of the lines were rejected because of the unsuitability to local consumer preferences. The local varieties generally have red skins with white to slightly yellow flesh. A number of IITA varieties had dark maroon skins and pink flesh or were very yellow.

The remaining 39 varieties were screened in the field for resistance/susceptibility to sweet potato virus. Nineteen lines are now being evaluated in the field for yield where they are being grown out against standard varieties. These trials are being conducted this year under rain-fed conditions.

iii) Pigeon Peas

A large number of pigeon pea varieties have been supplied by IITA. These have been planted out in observation trials but the crop has not been traditionally grown in Zimbabwe and it is doubtful that they will be incorporated into local food preference patterns.

iv) Tomato Varieties

Although not an IARC, it is worth noting here the role of AVRDC in supplying tomato varieties. The Lowveld Research Station requested heat tolerant varieties, because under low veld conditions there is a problem with fruit set because of the high daytime temperatures. Most of the varieties received, however, are yellow or pink skinned, while the local consumer preference is for red skinned tomatoes. Additional requests have been made to AVRDC and recently another 17 lines have arrived for testing.

c) Local Research Efforts being Overloaded by Requests to Test IARCs Material

It is clearly illustrated in section 2.4 that currently R&SS is experiencing a critical shortage of technicians, while at the same time, the department has a heavy commitment to ongoing research programs. It was a commonly expressed opinion that IARC material sent for testing by NARS programs is adversely affecting the work programs of local scientists. The most common complaints are:

- The sheer size of the material expected to be tested, which occupies valuable field space allocated to the crop program.
- The often complex and atypical plot designs, which place an extra burden on technical staff who have to change their normal procedures.
- The different and, at times, excessive observation and reporting expected during the growth of the crop, which is particularly difficult if the trial is grown on an off-station site where regular visits consume scarce departmental mileage allocations.
- Often the trial must be scored for disease and pest incidence and the researcher may not have had the necessary training.
- The preparation of detailed trial results and reports based on an IARC reporting schedule which is unfamiliar to local scientists.

These complaints are compounded to some degree by the inexperience of the local researchers. The person may only have been working on his program for a couple of years and may only just be getting accustomed to the department's established procedures. A senior breeder commented that the "mystique" of the IARCs and the feeling that young researchers may have to prove themselves to this "center of excellence" means that an excessive amount of time is devoted to these trials to the detriment of the local research program.

Detailed examples of some of these problems are presented below:-

The sorghum breeder was sent 100 sorghum varieties for testing by ICRISAT in 1979/80 and although the plot design and size was left to him, he found the detailed observation and the evaluation extremely time consuming. The reporting procedure required measurements of germination, establishment, regular disease and pest scoring and yield measurements.

He reported back in 1980 and received some 400 varieties for testing and his own selection. This volume of material was not requested and he was unable to handle the trial because of a critical labor shortage that he suffered. Currently, he is running a leaf disease nursery for ICRISAT and claims that, although this is a much smaller trial, it has involved training field staff in fairly complex scoring techniques.

The recent establishment of the ICRISAT regional center has now alleviated this pressure. When asked why he did not simply refuse to run the trial, he claimed that in the early stages he feared that this would restrict further material.

The agronomist at the Lowveld Research Station was asked to host a CIAT bean trial. This came as a result of a request to CIAT for climber beans to be incorporated in an inter-cropping program. The trial involved 40 entries of four different types of which only one type was a climber. The others were two field types and one coffee type. The trial layout was detailed by CIAT and space had been left in the design for him to insert local standards. The trial was run in 1982/83 and he found the reporting schedule time-consuming but was pleased that he was allowed to keep the material for his own germ-plasm collection.

The maize program has been innundated with CIMMYT trials since the head of the institute visited the center in 1980. He sees this as a service being offered to CIMMYT and of very little benefit to the national program. In 1982/83 Zimbabwe hosted four International Progeny Testing Trials (IPTT). These involved some 256 families by two replicates and he found that the trial seriously affected the manpower requirements of the national program. In addition, CIMMYT asked R&SS to run six Elite Variety Trials (EVT). This last season he asked for the volume of trials to be limited and ran only two IPTTs. This size of trial over-taxes the land resources allocated to the local program.

d) Failure of IARCs to Respond to Specific Requests

The agronomist at the Lowveld Research Station has a small project where he is investigating the possibility of growing rice in vleis (areas of high water table often found in the top of valleys between granite batholiths). Some local rice varieties are grown in these areas but they have very low yield potential. He made a very detailed and specific request to IITA for rice varieties which had drought resistance potential and were tolerant to cold and heat at flowering time. He received 80 varieties in 1981 and in good faith incorporated these into

detailed observation trials at three sites in Zimbabwe. The majority of them performed very poorly and after subsequent correspondence he obtained detailed descriptions of their ecological background. On the basis of these, he was able to ascertain that only 4-6 of the varieties sent had characteristics that were suitable for the type of environment he had requested.

These varieties have now been bulked up and on-farm trials have been conducted over the last two seasons in CAs in Masvingo Province. Unfortunately, the drought has been especially severe in these areas and most of the trials have failed.

e) Mandate Areas

A researcher working on cassava reported a very good example of how the division of the world by the IARCs into mandate areas can be detrimental to the effective transfer of biological material. The research work being undertaken by this scientist is funded by commercial sources and its objectives may in fact be slightly outside the stated CGIAR policy "to improve the quantity and quality of food production.... of poor people".

The provision of a cheap substitute source of carbohydrate for the brewing industry is the main rationale of this research. To achieve this, the program is evaluating and undertaking basic agronomic research on high yielding cassava varieties. As the ultimate end product sought is an industrial input, there is no concern given to the edible quality of the tuber. What is required is maximum carbohydrate yield per ha.

By studying available literature from CIAT and IITA, the researcher decided that the two organizations have different strategies. IITA scientists are concentrating on incorporating

sources of genetic resistance to cassava mosaic disease and cassava bacterial blight into material suitable as a food crop in the tropics. The material received from IITA has tended, under local conditions, to grow exceptionally tall and to produce very disease-free tubers, but without giving high yields.

CIATs cassava program has concentrated more on achieving yield increases and has done considerable work on cassava agronomy especially on establishing optimum planting densities and efficient fertilizer levels. In addition, some of the CIAT cassava breeding program has been undertaken at its savannah site at Carimagua, possibly making the material more suited to the highveld conditions found in Zimbabwe.

On the basis of this analysis, requests were made to CIAT for the supply of their cassava material for the local program. On these occasions, the researcher has had his request referred to IITA. Further requests have also been unsuccessful and he has been informed that the supply of any genetic material must be made through IITA because this center has the mandate for cassava research in Africa. Subsequent approaches to IITA for specific CIAT material have failed and to date the researcher has failed to obtain any cassava material from CIAT.

A more minor example of a similar situation is given by the researcher working on rice. After receiving what he considered to be unsuitable varieties from IITA (see previous section), he wrote to IRRI making a very specific request for material with good cold and heat tolerance at the flowering stage. Initially he received no reply to his request and, after a subsequent letter, received a reply stating that he should contact both IITA and WARDA for assistance.

3.2.5 The Collection of Local Germ-Plasm

A national collection of local germ-plasm is a very important exercise. Its storage for possible future use in breeding programs is as important as the preservation of the national heritage. IBPGR has given assistance to Zimbabwe in this respect. A comprehensive collection was made in 1982 and it is hoped that a similar collection exercise planned for 1984 will now take place in early 1985. This collection mission involved center staff and local researchers and is an example of how the collaboration of an IARC can stimulate and encourage a NARS in an important but previously neglected area. Prior to IBPGR's involvement there was no systematic collection of genetic material. The collection mission has been followed up by subsequent visits and funds have been made available to R&SS to construct a central refrigerated seed storage facility. The collection of local varieties has been co-ordinated with plant breeders working at R&SS and the mission devoted considerable attention to small grains (sorghum and millets) which form part of the country's new direction into research on CA crops. The preservation of genetic material and its systematic characterisation is an important exercise, but some personnel in R&SS have expressed concern about the manpower requirement that this may demand. The IBPGR descriptors that are used involve a considerable degree of detailed reporting on all aspects of the plants growth cycle. The characterisation of certain genetic material, already part of the R&SS crop breeding program (e.g. sorghum, millets, grain legumes) will not create too much of an additional burden. However, a number of smaller crops currently not given a high priority will require additional effort by already busy staff with limited resources. These minor crops include cucurbits, okra, sesame and amaranthus.

One of the personnel interviewed, while not involved with any IBPGR activities, expressed a dissatisfaction with what he saw as part of an exercise to "steal" the genetic resources of developing countries

and the use of IBPGR germ-plasm by multinational seed companies. This issue, given wide currency in some circles, needs to receive attention and shows there is some room for improving the center's image.

The collaboration of IBPGR with R&SS is performing a useful function and falls well within its mandate. This activity further illustrates the difficulty of measuring actual impact, the genetic collection being established may have no real impact at present, but at some future date, the collection could provide vital genetic material for one of R&SS's crop breeding programs.

3.3 Ideas, Research Techniques and Methodologies

In this section, the most difficult series of outputs of the IARCs to quantify will be discussed. The advanced level that the NARS has reached meant that there were very few new ideas or research techniques that the IARCs had to offer Zimbabwe. Possibly the biggest input of new research techniques has been the adoption by some of the breeding programs of disease scoring techniques used by the IARCs. This has happened with sorghum, groundnuts and especially the new crops like cowpeas and cassava.

Some personnel who have been on training courses at IARC claim that the experience has refined a lot of their research techniques, but has not significantly altered what they were doing before. One pertinent fact that some respondents brought up was that frequently the research techniques and methodologies used at the IARCs are not applicable here because the NARS lacks the necessary sophisticated equipment or trained manpower. For example, technicians from the Veterinary Service went for training at ILRAD. This was considered very useful, but impractical as the Veterinary Research Laboratory has none of the equipment that the technicians had the opportunity to use while they were there.

The Livestock and Pastures division is starting to devote more of its research effort to small stock such as goats and sheep. This class of livestock is found almost universally in the CAs and previously very little research had been done on them. The input from ILCA in helping formulate research objectives and in designing a research program is considered to be very valuable. The organization's extensive experience of small stock production systems in Africa should enable this new research effort to avoid many of the pitfalls that other national programs have encountered.

In addition to advice on small stock, ILCA has agreed to undertake a review of the whole livestock research program in Zimbabwe. The need to re-orientate the cattle research program so as to improve its relevance to the CAs is considered by senior staff at R&SS to be of top priority.

Possibly, the most important new research methodology introduced into Zimbabwe's NARS since Independence has been Farming System Research.

3.3.1 Farming System Research

This section does not intend to carry out a review of FSR, which has been done elsewhere in the literature. Rather, the role of FSR in the NARS will be discussed in depth.

At Independence, it was generally accepted by all personnel in the NARS that research was now going to have to be directed more towards peasant producers. This change in policy and new commitment to work on a previously little studied area was, in fact, simply looking for an operational methodology. Mike Collinson, part of CIMMYT's Kenya Regional office, came to Zimbabwe immediately after Independence and ran a demonstration exercise of the FSR cycle (background data

collection, informal survey and formal verification survey) for staff from the extension service, R&SS and the University's Department of Land Management. The study undertaken in Chibi CA was one of the first detailed systems evaluation of the peasant farming sector. The amount of useful data generated, coupled with its rapidity and low-cost, impressed all involved.

A second area was chosen and a multidisciplinary study was launched in Mangwende CA by the Agronomy Institute, Department of Land Management and the extension service in 1981.

By the time of the 1981/82 season, useful on-farm experiments were on the ground in the two areas. These experiments were unique in that they were specifically designed to investigate research problems identified in discussions with communal farmers. The Department of Land Management's role in this early FSR work was important as, at that time, there were no agricultural economists in R&SS (in fact there had never been a post for an economist in the history of the department).

By 1982, R&SS had decided to set up a separate Farming Systems Research Unit directly responsible to the deputy director and to remove the research from the auspices of the Agronomy Institute. The driving force behind this new arrangement was an IDRC-funded project to set up an animal production system research project, which would have been staffed by a person from ILCA. This new direction was designed to make the FSR Unit truly multidisciplinary and to get it to focus on both crop and livestock problems. The establishment of this unit was delayed when ILCA failed to finalize its memorandum of understanding with the Government of Zimbabwe.

The project was then re-worked and an IDRC funded post was established to head the new unit. Accordingly, towards the end of 1983, an experienced agricultural economist from Belize was appointed and the Farming System Unit formally established. The agronomist,

who had been working on the previous projects, was transferred to the unit as was a small stock expert from Henderson Research Station, and a livestock specialist from Grassland Research Station. The unit has just completed a new diagnostic phase in Chibi and Mangwende involving additional personnel from ILCA. It was argued that the original FSR work undertaken by CIMMYT did not have enough of livestock orientation and that the on-farm experiments generated by these surveys tended to concentrate mainly on this center's mandate crop, maize. This is possibly a reasonable criticism and clearly indicates the problems of having something as universal as FSR being confined to an organization with a specific mandate restriction. The CIMMYT personnel who regularly visit the country in connection with their on-going workshop programs continue to make contributions to the unit by way of advice and suggestions.

A member of the directorate of R&SS claims that they are extremely pleased to have the unit run by an IDRC-funded person as they feel that this ensures a balanced approach to FSR, which incorporates the different orientations of both ILCA and CIMMYT. This local combination of two different IARC approaches appears to be a useful development, and should be expanded. A senior staff member of ICRISAT commented that the next logical expansion would be the incorporation of small grain specialists from that organization's FSR program.

The FSR program at R&SS has been using this new diagnostic phase to involve research station staff in an attempt to get a more unified commitment to the new methodology. This program has evoked some very strong views by other scientists in R&SS, which range from almost religious conversion to extreme scepticism about the methodology's usefulness. One breeder interviewed claimed that he didn't need an economist to tell him what varieties he should be breeding.

Possibly, the most reasonable view came from the Director of R&SS, who claimed that FSR was just another research tool and one that, if successful, would still require the backup of a sound and efficient station based research input.

What has been the impact of this new methodology? Many of those interviewed feel that it is too early to judge, while others claim that FSR has done more to re-orientate research workers' approach towards the problems in the communal areas than anything else. Some report that the interaction with peasant producers has created a genuine realisation of the problems they face and highlighted the importance of developing relevant farmer-based technologies. This has been instrumental in really motivating research workers and giving them a meaningful sense of purpose in their work.

A senior person in the extension service claims that on-farm research has been important in motivating the extension workers in the area and is serving as a valuable extension tool. The trials are used by the extension staff for field days and visits and the relevance of the technologies being tested is improving the confidence of the farmers in the extension workers and in their advice.

3.3.2 An IARC Without Specific Research Impact But Involved In Ideas and Policies: IFPRI

IFPRI has a mandate to create an awareness of food security problems and to communicate the results of their investigations to national Governments in the hope that this will result in meaningful policy changes. Some of the respondents interviewed claimed that IFPRI was very good and possibly produced the most professional studies undertaken by any IARC. Others had either no knowledge of it or only knew that it had held a workshop on food security issues in 1983.

The papers the center produces and the conferences they hold are of high academic quality, but of limited impact given the amount written about the food crisis and the intractability of the problem.

IFPRI is currently preparing for a research program in Zimbabwe on marketing, social infrastructural development and services. This program was strongly criticised by one respondent who claimed the research is for the center in Washington and will form the basis of a very good paper. However, this exercise could have been used to contribute to the personal capacity of local researchers. The staff of IFPRI are extremely good and a local agricultural economist would have really benefited if the research program had incorporated some local personnel. The work of IFPRI is claimed to be too centralised in Washington, and therefore, its impact in generating useful policy redirections in developing countries are very limited.

The above paragraphs provoked an extremely strong response from the center in which it claimed that the comments were "being used to create considerable mischief for IFPRI". This was certainly not the intention of the author and it is therefore fair to present in detail the center's comments.

The proposed research program has not as yet started and IFPRI has involved local personnel from the Department of Physical Planning, Ministry of Local Government and Town Planning. The proposed research team will in fact involve three members of this department working with the IFPRI Research Fellow. While it is regretted that this fact was not picked up during the impact study interviews the original comments made by a member of the University must be seen in the context in which they were made. The high academic excellence of IFPRI research was thought to be more usefully related to the agricultural economic research programs of the University than to the Department of Physical Planning which does not have a research

section and deals mainly with physical infrastructural planning in rural areas.

The center also points out that the workshop held jointly by the University of Zimbabwe and IFPRI in 1983 was not a country-specific undertaking and therefore its impact can not properly be evaluated on the basis of some respondents in Zimbabwe. Since receiving IFPRI's reply, the author has had the opportunity to discuss the workshop with a couple of senior civil servants, who attended it. Both commented that the meeting was extremely useful as it gave them the opportunity to meet and interact with similarly positioned personnel from other countries in the region. This interaction has formed the basis for continued communication on the problems of regional food security policy which are now formalized under a SADCC program.

3.4 Research Organization

The most significant input of the IARCs in altering the research organization in Zimbabwe to date has been the creation of a separate Farming System Research Unit in R&SS (this is described fully in the previous section).

(a) Role of ISNAR

ISNAR has recently completed a study on the training needs of R&SS. This report is still in its draft final stage but is considered a very significant contribution to the future organization development of R&SS.

The document produced is extremely thorough and should go a long way towards the development of a viable training strategy in the department. The funds for such a training program are available from a number of sources, mainly the

World Bank and USAID. This strategy, if implemented, will help strengthen the capacity and competence of the organization.

Despite a few errors in the document (ISNAR was not aware that prior to 1974 the University of Zimbabwe issued University of London degrees), most people interviewed, thought that a coherent training policy is vital and that the key issues had been clearly set out in the report. The urgency of some of ISNAR observations have recently been proved extremely correct. The report noted that unless the frustrations of certain research workers to be allowed to pursue higher degrees were met, it was felt that R&SS could lose their services. At the end of August 1984, the agronomist in charge of the cowpea program and the maize breeder both joined the University of Zimbabwe as part of a staff development program that includes PhD training at Michigan State University under a USAID program.

b) Regional Co-operation

Many of the people interviewed cited the fact that regional workshops and meetings organized by IARCs had gone a long way towards improving the communication and co-operation between the NARS of neighbouring countries. Many useful contacts have been established between scientists in the regions which have resulted in extremely useful exchanges of information and ideas.

Many felt that this interaction was more important than the content of the workshops and two people interviewed suggested that the IARCs arrange annual meetings of scientists working in related fields.

3.5 Training and Information

3.5.1 Training

An important function of the IARCs is to provide training to NARS staff in their mandate crops or areas of responsibility. The stated purpose of this training is to help improve the efficiency and performance of the NARS and by the development of local personnel make the country's own efforts more self-sufficient and proficient in the conduct of its research programs.

This section will examine elements of the IARC's training programs and attempt to evaluate the impact these efforts have had in Zimbabwe. As stated in Section 3.1 the status of the NARS is often the most important factor in predetermining the possible impact of any of the IARC's activities and the field of training is in no way different. The peculiarities of the NARS that have made the training effort of the IARCs useful or reduced their effectiveness are discussed first. The latter part of this section contains a number of comments, related to training, given by respondents during the course of the interviews.

a) Number of Newly Recruited Researchers in the NARS

As detailed in Section 2.4, there is a high proportion of newly recruited staff members in R&SS. Some of these new recruits have returned home from other research institutes in Africa or abroad and are reasonably experienced research workers. This group of recruits have, because of their previous experience, been incorporated into the upper echelons of the NARS. In these positions, they are more

involved with the management of staff and programs than with actual research.

The greater proportion of new staff members are, however, recent graduates of either the local University or overseas institutions. These researchers have been incorporated into a NARS which has a number of ongoing research programs and, for many, the heavy responsibility of running an advanced research program, has suddenly been thrust upon them. University training both in Zimbabwe and elsewhere is rightly criticized for lacking a practical component in the syllabus. Equally, most graduates have very general degrees while their research program require detailed knowledge of a very narrow field.

b) The Number of New Crops Being Studied by the NARS

In Zimbabwe, research on cowpeas, cassava, rice, small ruminants and inter-cropping for example, is entirely new and no experience exists in these new fields.

These factors described in a) and b) have enabled the NARS in Zimbabwe to genuinely benefit from some courses offered by IARCs. The opportunity for newly recruited researchers to spend time at an international center, specializing in their research topic, has been a means of quickly training them in the appropriate techniques and procedures required.

In this respect, the following courses have been given as examples of the beneficial impact of the training programs offered by IARCs.

Wheat breeding course	- CIMMYT
Wheat pathology course	- CIMMYT
Groundnuts production course	- ICRISAT
Sorghum production course	- ICRISAT
Root and tuber crop production course	- IITA
Rice production course	- IITA
Animal nutrition course	- ILCA

In addition to the above, a course run by ISNAR, in Swaziland, on research management was cited as very useful by senior staff who attended.

The student fellowship program offered by IITA to undergraduates at the Faculty of Agriculture, University of Zimbabwe, is considered to be extremely useful, more as a life building experience than for the research techniques and work experience they get. Most students, who attend the course, develop more favorable attitudes to their undergraduate studies after their visit.

c) General Criticism of Training Programs

i) Training courses too general

Many of those interviewed criticized the content of some of the courses offered by the IARCs. The course material was too broad and general, and for some, too basic. The level of training seems to be pitched at the least educated and experienced member of the course.

ii) Participants not stratified according to ability

This relates to the first point. It is not uncommon to find

experienced breeders in a course with research technicians or agricultural research assistants.

iii) Courses are too long

The length of the course and its timing should be more flexible. For example, a 9 month course at CIMMYT can result in staff of the NARS effectively missing two full seasons work.

It was felt that if more attention was paid by the IARCs to tailoring course work to individual requirements, interests and abilities, they would be more effective and useful.

iv) No follow-up of trainees

The IARCs appear to make no attempt to follow up the trainees who pass through their training programs. Continued contact and possibly additional support would make the training more effective. The exception to this comment is researchers working on regional programs with IARC staff who visit regularly.

v) Lack of graduate training support

The IARCs have been developed on the assumption that a "critical mass" of scientists is essential to assure effective research work. Thus, the center represents a concentration of experienced and professional scientists in an area where post-graduate researchers and university programs are struggling to find suitable qualified supervisors and temporary lecturers. The use of ICIPE as a graduate training institute is cited as the sort of

development of training strategies that the IARCs should aim for.

It is encouraging to note that the ICRISAT regional sorghum and millet program being set up in Zimbabwe has built into it a provision for the experienced staff to supervise and offer support to post graduate students working on the small grains in the SADCC region.

d) Positive Aspects of Some IARCs Training Programs

The CIMMYT regional FSR workshops, because they are held in-country, are extremely effective and enable the various country scientists involved in research to be brought together. This is extremely useful as the research technique being taught has as its main objective the establishment of multi-disciplinary research efforts into the problems facing peasant producers and the development of appropriate research programs to solve them.

In addition the FSR program being run by CIMMYT in East and Central Africa has, as one of its ultimate objectives, the development and expansion of local participation in the training. To this end CIMMYT has formed a relationship with the Department of Land Management, University of Zimbabwe, and has run a series of joint regional workshops. It is planned that once local lecturers and researchers have gained enough experience, they will take over the running of this program. By adopting this approach, CIMMYT has been actively involved in developing local training capacity which will, in the future, be used to train local researchers and undergraduates.

Many of the IARCs are not fully exploiting the benefits that can be obtained by running in-country training programs. For example, all the participants in the ISNAR Research Management workshop claim that its effectiveness and usefulness would have been increased if the

course had been run in Zimbabwe where the local management procedures and administrative mechanisms could also have been taught. This would have reinforced the impact of the management training given.

Another notable exception to the general criticism of IARC training policies is the award of an ILCA study fellowship to a Zimbabwean livestock breeder. The person was supervised in his research analysis and dissertation write-up by one of ILCAs experienced animal breeders. Most important in his field of work was that he was able to analyse his enormous amount of data on the ILCA computer facility with the support of the center's biometrician and its developed livestock data analysis programs. This activity not only aided an individual in obtaining a higher degree but also resulted in the write up and analysis of an enormous amount of important livestock research that might never have emerged from the thousands of raw data books in which it had been recorded.

3.5.2 Workshops and Conferences

These fall in between pure training and information. All those interviewed praised IARC-organized regional workshops they had attended.

The opportunity to meet, discuss and establish contact with fellow scientists working in the same field was cited as the most useful aspects of these gatherings.

Among workshops cited as being extremely beneficial were:

Small ruminant productivity in africa	- ILCA
Grain legume workshop	- IITA
Regional groundnut workshop	- ICRISAT
Rice production workshop	- IITA - IRRI
Farming system research workshop	- CIMMYT
Potato development and transfer of technology in tropical africa	- CIP
Potato post harvest workshop	- CIP.

Some respondents cited the IFPRI workshop on agricultural policy and food issues held in Zimbabwe as one of the best conferences or workshops they had attended. However, others who attended questioned whether simply discussing issues of this nature could have any real effect on altering agricultural policy.

3.5.3 Information

Most of those interviewed praised the flow of information between the IARCs and NARS. The centers' newsletters were all considered extremely useful because they keep researchers up-to-date on recent developments. A number of information services received special mention.

a) ILCA's Selective Dissemination Information Service (SDIS)

All researchers in the livestock field cited this as extremely useful. The fact that key subject words can be given and the computer facility ensures that the researchers get regular abstracts of relevant literature was considered very helpful. The shortage of foreign currency restricts the number of international journals that the NARS gets and the isolation of some researchers on stations away from the head office library service compounds this problem.

One researcher pointed out that a service of this nature is only as useful as the end uses it is put to by the individual researchers.

b) ILCA's microfiche collection of Zimbabwean
livestock documents

In 1983, ILCA microfiched an enormous collection of unpublished documents about livestock in Zimbabwe. These documents are now accessible to all researchers. The rapid staff turnover in the division and the enormous amount of unpublished data filling old cupboards and in danger of being discarded makes this collection extremely valuable for current and future researchers.

c) Criticisms of Communication between NARS and IARCs

Two centers were mentioned as being very bad at replying to letters and requests for information, namely IRRI and IITA. One University researcher working with IITA material claims that while letters and telexes had gone unanswered for months, when a local pathologist thought he had identified bacterial blight in some IITA material, an IITA pathologist arrived within two weeks (the identification of the blight was in fact incorrect).

Contrary to the criticism mentioned above, a Government researcher working with IITA claims that he has no problem communicating with the center, except for what could be considered normal postal delay.

A number of researchers complained that often important information was sent to their superiors or the directorate and never reached them. This criticism is more a management problem in the NARS. One of the items cited here was the annual reports of the centers. Often

only a couple of copies of the report were sent to Head Office where they sat on the Director's coffee table and were never circulated. The reports were all thought of as very useful documents which should be sent directly to all researchers or stations involved with the centers.

3.6 Relationship between IARCs and NARS

The relationship between the National Agricultural Research System in Zimbabwe and the international centers is considered to be beneficial by all the people interviewed. The provision of biological material especially for crops programs orientated towards the communal areas and the provision of training in specific areas has been isolated by most respondents as the activities of the IARCs which are the most complementary to the aims and objectives of the country's research program.

Zimbabwe has benefited considerably from this relationship, the effects of which will take some time to reach fruition. The research system in Zimbabwe is moving in a new direction in its research orientation and strategy. The IARCs which have had experience in this type of research can help considerably. The research service is relatively inexperienced, but is highly competent. By realising this and offering genuine support and encouragement, the IARCs could make a significant contribution towards the continued development of research in Zimbabwe.

Equally, the strength of the NARS in Zimbabwe could be used by the IARCs to benefit the other countries in the region. The good infrastructure in Zimbabwe generally and specifically in the research system could form the basis of viable regional programs for the benefit of large parts of Central and Eastern Africa.

One such program in the process of being established is ICRISAT's regional sorghum and millet research program which will be stationed at the Matopos Research Station near Bulawayo, and will serve as a regional program for the SADCC countries.

These small grains are important crops in the region and very little research and improvement has gone into them. Given the growing food crisis in the region, these drought resistant crops could make a very important contribution to the overall food security situation.

The program has a number of elements which appear at this early stage to make it a model for other such regional centers. The program has a strong commitment to training local and regional scientists and plans at all stages to involve the regional personnel in its program. If its objective is realised, the center will not only result in the development of useful biological material but will also strengthen the capacity of local national programs.

The speed with which the program has already moved is impressive. In the 1983/84 season some 4,500 varieties were tested at five sites in the region. In Zimbabwe the best varieties have been selected and crossed and the progeny planted out by August 1984 using an off season nursery site at Mazarabani. This coming season the program will be able to start field tests on these crosses. The only danger with the speed at which the program is developing is that it may start to overshadow the local sorghum breeding program.

Despite this possible problem, many respondents who were interviewed, noted that for the IARC to be really effective, more regional efforts must be made. Very few of the IARC are operating in conditions typical of the conditions found in Zimbabwe and its neighbours.

There should be more involvement of the national personnel in the management and direction of the international centers. This will

ensure that better feed-back occurs and will help to ensure that the objectives of the NARS are reflected in the work and direction of the IARCs. This is in fact happening in Zimbabwe. The Director of R&SS is on the ILCA board, and the Deputy Secretary of Agriculture and former head of the Veterinary Department is on the ILRAD board. This process should be expanded.

CHAPTER FOUR

RESEARCH IMPACT ON AGRICULTURAL PRODUCTION IN ZIMBABWE

This section will attempt to cover the major research generated innovations that have lead to changes in the production patterns and yields of the main crops in Zimbabwe. It will concentrate mainly on the important food crops but consideration will also be given to the key cash crops.

There are big differences between the two sub-sectors of agriculture in Zimbabwe (as described in Section 1.3.1), and attempts will be made to describe the changes that have occurred in both the commercial and communal farming areas. The latter sub-sector is possibly the most important in terms of measuring the impact of research on the standard of living of the major portion of the population in Zimbabwe. However, it is this sector that suffers most from an inadequate data base. Crop area and yield estimates are notoriously unreliable for the communal areas and are normally based on the observations of extension field staff. The introduction of program planning in the late sixties where extension staff were asked to detail their annual work objectives in terms of increases in the area under certain target crops or in the improvement of yields, has further complicated the issue. Field staff have unfortunately taken the annual crop estimates exercise as part of the evaluation of their performance and many have incorporated their planned objectives, often wildly optimistic, into the estimate of the area under a crop and in the estimated average yields obtained by farmers.

The major portion of the communal area crops are either consumed or sold locally and therefore total production estimates have been based on the total marketed output plus a rough estimate on household

retentions. These retentions, however, have been radically affected in recent years by the high food subsidies and the improved marketing facilities that now exist in communal areas. These have encouraged farmers to sell the majority of their crop and to re-purchase milled maize-meal. Changes in the price differential between depot and food prices have caused large variations in the retention strategies of communal area farmers. No detailed studies of this important variable have been undertaken in Zimbabwe and at best total production estimates (on which average yield assessments are made) can be considered only as general indicators.

4.1 Major Crops

4.1.1 Maize

The increase in the yields of maize over the last three decades has been impressive. In the commercial sector average yields have increase 3.3 fold and in the communal area they have doubled. As maize is the major food crop in Zimbabwe, a detailed analysis of the various technologies generated by research are discussed in detail for both the commercial and communal areas.

Table 27: Maize Crop Production in Zimbabwe 1951-1955 and 1976-1980

		Area (hectares)	Production (tonnes)	Yield (kg/ha)
LSCFA	1951-55	145,000	207,068	1,421
	1976-80	212,450	1,008,136	4,726
SSCFA	1951-55	-	-	-
	1976-80	29,825	53,263	1,786
CA	1951-55	628,751	217,103	342
	1976-80	738,400	514,800	695

Source : J.R. Tattersfield, 1982

a) Commercial farming area

i) Varieties

All the commercial maize grown in Zimbabwe is hybrid maize and the variety SR52 comprises 85% of the crop, the remaining 15% being the shorter season hybrids R200, R201, or newer releases. A brief history of hybrid maize in Zimbabwe is given in Section 3.2.4. In 1950, the commercial crop consisted entirely of open-pollinated varieties, the main one being Southern Cross. In multi-site trials in the sixties SR52 gave yield increases averaging 46% above the yields achieved by Southern Cross.

The shorter season hybrids, although slightly lower-yielding than SR52, would have given a similar yield advantage under the lower rainfall conditions under which they are normally grown.

The development of hybrids alone are thought to be responsible for about 45% of the total per increase in the average commercial maize yields noted between 1950 and 1980.

ii) Fertilizer

In the 1950s although the use of organic nitrogen was recommended, only about one quarter of the maize producers used either green manuring or composting to provide nitrogen. In addition, about 40 kg/ha of phosphorous was recommended in the form of single superphosphate.

Currently, most farmers use nitrogenous compound fertilizers at the rate of 150 kg/ha nitrogen, 40 kg/ha phosphorous and 30 kg/ha potassium. The fertilizer used is often based on detailed soil analysis and determined by the economic yield

potential. Research data from nitrogenous fertilizer trials shows that their use can result in yield increases of the order of 200%. This is by far the biggest single contribution to the yield increases experienced in commercial maize production.

iii) Plant Populations

The introduction of hybrids and the use of fertilizer have enabled plant populations to be significantly increased from the recommended 24,000 plants/ha to 36,000 plants/ha for SR52 and 48,000 plants/ha for the earlier maturing varieties. This change in recommended plant populations has been shown to result in a 16% yield increase with SR52 and 32% increase with R200.

iv) Planting Dates

The short rainy season in Zimbabwe requires early planting to ensure maximum yields. Research work has revealed that on average there is a 5% reduction in yield for every one week delay in planting date.

During the fifties, early weed growth was harrowed in first before planting. The cessation of this practice and the development of multiple row mechanical planters has enabled today's commercial growers to generally plant 2-3 weeks earlier, which could have resulted in about a 15% yield increase.

v) Weed Control

A considerable amount of research has been undertaken on weeds in maize over the last 20 years. The crop was weeded entirely with hoes and cultivators (often ox-drawn) in the 1950s. Today about 75% to 80% of the commercial crop is treated with herbicides and tremendous advances have been made in the development of faster and more efficient

mechanical cultivators. Apart from the significant reduction in the labor input required by the crop, effective weed control is estimated to account for about a 30% yield increase.

vi) Pest Control

The major pest of maize is the stalk borer Busseola fusca. In addition, periodic outbreaks of snout beetles and cutworms also significantly reduced yields. The development of efficient and cheap chemical control measures coupled with improved agronomic practices based on research into the pest life cycles have resulted in between 5-10% increase in yields.

vii) Improved Harvesting

The recommended practice in the 1950s was to cut the maize and stook it to facilitate drying. The modern practice of combining and the use of crop dryers has resulted in the removal of the approximate 5% yield loss that drying in the field resulted in.

These innovations largely adopted by most commercial growers can account for the over 300% yield increase experienced between the 1950s and 1980s. There is, of course, large variation in average yields. Staff and research workers explain this variation in the basis of different managerial expertise, soil and rainfall variation. These innovations have largely been the result of detailed research by crop breeders, maize agronomists, agricultural engineers and entomologists. Their adoption by the commercial farmers, however, has been largely facilitated by a number of factors which include easy access to credit facilities and the high degree of mechanisation of this group of farmers. More important, however, is the agro-industrial complex developed in Zimbabwe, which has enabled the research findings on fertilizer to be translated into the full range

of compound fertilizers universally available at reasonable prices. The high capital and recurrent costs of these innovations would have prevented their adoption if they had not been supported by a good producer price for the crop, efficient and well distributed grain purchasing depots and an undertaking by the pre-Independence government to offer financial relief to large scale farmers in the event of crop failure as a result of drought.

b) Communal farming areas

Over the last 20 years, one of the most significant changes in the cropping pattern of the communal area has been the rapid expansion of the area under maize. The reasons for the expansion of maize will be covered below. However, the significant point is that a considerable proportion of the expansion in the maize area has occurred in communal areas in Natural Regions IV and V. These areas are not favorable to maize production because of the high incidence of mid-season drought to which the crop is particularly vulnerable if it coincides with the silking period. This expansion of maize in marginal areas (which comprise the major portion of the CAs) have not lead to the same level of increase experienced in the average yields of commercial producers who mainly grow the crop in Natural Regions II and III.

Studies in both Mangwende CA and Chibi CA using a "farming systems approach" illustrate that there has been a significant change in local food preferences away from the small grains (bullrush millet and sorghum) towards maize. A secondary effect has been the widespread establishment of small grinding mills in the communal areas. These mills have removed the arduous labor required on the part of women to hand-pound the grain into meal. In addition, local millers are reluctant to grind the small grains as the higher percentage of testa in these grains tends to clog the mill.

i) Varieties

Various studies in the CAs all contain evidence of an exceptionally high level of adoption of hybrid maize varieties. In Mangwende and Mrewa CA, both in natural Region II, the use of hybrid maize is almost universal. In addition to adopting the use of hybrids, farmers in this area appear to be fully conversant and responsive to the properties of the various hybrids available. SR52 has replaced SR14, because of its higher yield. R201 has replaced R200 which was more susceptible to weevil attack. Farmers in the area have adopted a staggered maize planting strategy as a means of risk aversion against the possibility of a mid-season drought. They use the varying maturation period of the hybrids to good effect. While 33% of the first maize plantings is the longer season variety SR52 and 52% the shorter season R201, the third planting comprises only 12% SR52 and 65% R201.

In Chibi CA which is mainly in Natural Region IV and V, the effects of the shorter season hybrids released in the seventies is extremely significant. Only 10% of the farmers in the area were using hybrids in 1970 but by the 1980/81 season this figure had jumped to over 85%. This high level of adoption is most impressive and is largely a result of the easy availability of the hybrid seed at a reasonable price and in appropriate sized packages. The adoption must also be related to the acceptability of the hybrids as a food source and to the obvious yield increase that they give to farmers using them.

ii) Fertilizer

The use of fertilizer on maize has been increasing steadily

in areas with a favorable rainfall. For example in Mangwende, a survey gave the following results:

Table 28: Percentage of Farmers in Mangwende CA, Using Fertilizer on Maize for Different Periods

	Before 1970	1970-75	1975-80	1980-81
% Of farmers using fertilizer	32.4	48.7	87.5	100

Source: Diagnostic Survey of Mangwende CA - Agronomy Institute R&SS, 1984

All farmers now use fertilizer and this has been facilitated by the easier access to credit for the purchase of inputs. In addition, it illustrates how maize has become both the major food crop and an important cash crop.

The yields in the area are very high, in fact nearly four times higher than the average for all the CAs. In addition, the reported increases in average yields over time are extremely good and appear to be related to the increased use of chemical fertilizers and hybrid seed. The average maize yield in 1971 was only 0.36 t/ha, while in 1978 it had jumped to 1.4 t/ha and in 1982 it was 2.80 t/ha.

In the drier areas, where there is less reliable rainfall, the use of fertilizer has not been encouraged. In Chibi CA, for example, only 4% of farmers purchased fertilizer in 1981 and only 15% of the farmers reported ever using it.

4.1.2 Groundnuts

Table 29: Groundnut Production in Zimbabwe 1951-1955 and 1976-1980

		Area (hectares)	Production (tonnes)	Yield (kg/ha)
LSCFA	1951-55	2,908	1,562	560
	1976-80	3,394	7,980	2,335
SSCFA	1951-55	-	-	-
	1976-80	11,811	6,559	551
CA	1951-55	175,604	45,462	258
	1976-80	250,000	123,400	481

Source: J.R. Tattersfield (1982)

Until the late sixties, almost all the groundnuts in Zimbabwe were grown under rain-fed conditions. The development of long season varieties by local breeders has lead to a large number of large-scale commercial growers growing the crop under irrigation. By starting the crop before the rains and supplementing with irrigation during any dry spells, very high yields can be obtained. These yields which are among the highest achieved in the world under commercial conditions are possible because of commensurate advances made by research into disease and insect control. Leaf diseases, a major problem on the crop, are controlled by the use of fungicides.

The advances in plant breeding have been directed mainly at the commercial crop grown under irrigation and the most successful hybrids produced have been long season varieties. Most of these advances have not been of a major benefit to communal producers. This crop, once a major cash crop in the CAs, has recently experienced a serious decline. Between 1955 and 1976, sales from this sector averaged 19,000 t of shelled nuts per year. Since 1977 sales have fallen rapidly and in 1982 totalled less than 1500 t. The majority of the crop is either consumed locally or enters the

informal market as the producer price is grossly inadequate for small scale producers.

The production of the crop in the communal sector faced a number of other problems which include its high labor requirement, lack of seed and rosette virus (Shumba 1981).

The crop has a very high labor requirement and its production in the communal areas is dependent on the recruitment of work parties. This practice was made difficult by the hostilities experienced during the liberation war and this led to a decline in production.

The heavy rainy season in 1980/81 which water-logged the crop and the subsequent droughts have further reduced the available seed stocks.

Rosette virus is now a serious disease in the communal crop. This disease, transmitted by aphids is fairly easily controlled by improved cultural techniques (dense plant populations reduce aphid infestation). However, the sparse plant populations found in the communal sector have encouraged this disease.

An urgent research requirement for the communal areas would be the development of a rosette resistant groundnut variety. Although research is being undertaken on this subject by both R&SS and the Crop Science Department of the University of Zimbabwe, the long term problem appears to be the lack of adequate price incentives to commercial seed producers. Local breeders have recently released new varieties to the local seed producers but the very low controlled price paid for the crop has not been enough to encourage production of sufficient seed for sale in the country.

The major factor in the increase in yield experienced by CA farmers shown in Table 29 is thought to be the adoption of chemical fertilizers. Single superphosphate applied prior to planting can

more than double yields and the application of gypsum (Calcium sulphate) at the start of flowering also significantly increases yields.

4.1.3 Cotton

The commercial production of cotton in Zimbabwe was made possible by the development of effective chemical control measures in the late 1960s. In the period 1951/55 large scale commercial farmers' yields averaged 256 kg/ha, which increased to an average of over 1,700 kg/ha for the period 1976/80.

In this period (1976/80), CA yields were only 722 kg/ha. Before the early 1960s, the farmers in these areas were actively discouraged from growing cotton. It was thought by the colonial government that peasant producers lacked the managerial expertise to grow the crop with the correct agronomic practices. It was feared that low level technology production of cotton without effective insect control would lead to a rapid build-up of resistance in the pest spectrum. In the 1960s cotton was introduced to peasant farmers in Gokwe CA, accompanied by a massive extension effort. The rapid adoption of the crop by farmers in the area was spectacular. During the 1963/64 season some 13 ha were grown and sales were only 19 t. Within three years the area had increased to over 1,000 ha and total production had surpassed 1,400 t. By 1971/72 over 13,000 ha were under the crop and over 12,000 t were being produced. This last season (1983/84), the area produced over 46,000 t of cotton worth close to Z\$ 30 million.

A good pricing policy coupled with the provision of good marketing facilities have been the vehicles for the massive expansion in this crop. However, many of the improvements in cultural practices have been the result of research and extension by both the extension

service itself and the Cotton Training Institute which is operated by the Cotton Producers Association.

The biggest contribution by research has been in the control of the major pests. The recommended chemical control measures have been perfected by the Cotton Research Institute and a universally applied system of rotation in the use of these chemicals has limited the problem of a build-up of resistance. Detailed and effective methods of scouting and the determination of the economic threshold of various pests have led to improved pesticide application regimes.

Cotton seed is an important source of edible oil in Zimbabwe, and considerable advances have been made by plant breeders to increase oil production. In addition, breeders have produced a series of varieties over the years with improved yield, better ginning quality and resistance to jassids and black arm disease. Farmers must obtain new acid de-lintified seed each season and new varieties can be easily introduced once they are bulked up.

The recent increase in the minimum wages of agricultural workers on commercial farms has decreased the viability of cotton in this sector. However, the high labor demand at picking makes it ideally suited to the CAs, which have considerable surplus labor. In recent seasons the CA's share of the crop has expanded significantly and now over two thirds of the crop is produced by this sector. The original research into cotton could, therefore, be considered as one of the peasant-sector's biggest benefits from agricultural research in Zimbabwe.

4.1.4 Soya Beans

Table 30: Soya Bean Production in Zimbabwe 1951-1955 and 1976-1980

		Area (hectares)	Production (tonnes)	Yield (kg/ha)
LSCFA	1951-55	231	97	470
	1976-80	32,700	66,656	2,011
SSCFA	1951-55	-	-	-
	1976-80	611	378	675
CA	1951-55	-	-	-
	1976-80	7,462	5,156	624

Source: J.R. Tattersfield, 1982

The expansion of the crop in the sixties was largely the result of very successful research. Initial work on Rhizobium resulted in the development of very effective legume inoculants. These are available to farmers from R&SS's inoculant production facility and possibly have made a significant contribution to the overall yield increase experienced.

In addition, crop breeders have produced varieties suitable for Zimbabwe with high yield potentials. Basic research on the crop's agronomy has resulted in appropriate management and cultural practices. The pest spectrum has been extensively researched and efficient control measures developed. The major thrust of research has again been towards commercial production. For example, a major objective of the breeding program in the last five years has been the development of varieties suitable for combine harvesting.

The crop is expanding in the CAs with better rainfall, but more research on the production of this crop under smallholder production techniques needs to be done. Research on the semi-looper caterpillar (Plusia sp) has resulted in a possible biological control measure suitable to peasant producers. Caterpillars infected by a natural

occurring virus can be collected and an extract used to spray the crop, resulting in reasonable control of the pest.

4.1.5 Munga and Rapoko

These two local small grains, grown exclusively by communal farmers, are a bullrush and a finger millet.

Table 31: Bullrush Millet (Munga) Production in Zimbabwe 1951-1955 and 1976-80

		Area (hectares)	Production (tonnes)	Yield (kg/ha)
	1951-55	-	-	-
SSCFA	1976-80	1,444	878	606
CA	1951-55	97,853	52,233	531
	1976-80	339,800	130,090	385

Table 32: Finger Millet (Rapoko) Production in Zimbabwe 1951-1955 and 1976-80

		Area (hectares)	Production (tonnes)	Yield (kg/ha)
	1951-55	-	-	-
SSCFA	1976-80	2,995	2,288	762
CA	1951-55	91,347	56,368	605
	1976-80	116,500	60,340	493

Source: J.R. Tattersfield, 1982

The yields of both crops have declined over the period studied. The replacement of small grains like munga by maize in the more favorable areas could have resulted in a larger proportion of the crop being grown in lower rainfall regimes, leading to a drop in yields.

Rapoko plays an important cultural role in Shona society as a food source and beer component and has remained a significant part of the cropping system even in the better rainfall area.

These two crops have had almost no research undertaken on them until very recently. The downward yield trends and their importance to communal areas would indicate the urgent need for a larger research effort on these crops.

4.2 Livestock

In this section, consideration will be given to advances in the area of livestock which have been the result of research.

4.2.1 Cattle

From the earliest days of colonisation, the country was seen as suitable for cattle ranching. The resident tribespeople had large herds and cattle played a vital role in their society. The country suffered serious pandemics at the turn of the century (see section 4.2.3 below) and large parts of the country were infested by tsetse fly (see section 4.2.4 below).

Large scale commercial ranching became an important activity in the early part of this century. One of the first activities was the importation of exotic breeds from the United Kingdom (Shorthorns, Herefords, Freislands and Aberdeen Angus). These were cross bred with local cattle and a process of grading up the local cattle was undertaken. As the beef market developed, more exotic breeds with suitable characteristics were imported. Much of the early research work was undertaken on the suitability and performance of these

various varieties of cattle. Almost no research was undertaken on the indigenous breeds.

A major research input into the beef industry has been on improving the feeding regimes of ranch animals. The provision of either protein rich concentrates or licks to breeding cattle in winter has significantly increased productivity. Between 1968 and 1972, for example, calving rates in commercial herds increased from 52% to 60%. Annual offtake increased from 10% to 20% in the same period. (Oliver, 1983). Recent changes in the prices of these winter concentrates have now made these practices marginally uneconomic and in response, many commercial producers are turning to improved or irrigated pastures. Most of this livestock research was not really applicable to the CAs. Here cattle hold a vital and complex role in the social, spiritual and economic life of the people. (Chavanduka, 1976). Offtake of the communal herd is below 1% and more animals died in the recent drought than were sold over the last two years. Some success has been achieved in improving grazing management by introducing paddock systems but the high infrastructural costs and the difficulty of managing communal property has led to the failure of many of the schemes.

It is worth noting again that very little research has been undertaken on goats which form an important part of the livestock in the CAs.

4.2.2 Pasture Research

Zimbabwe has been a leader in Africa in the field of improved pasture research. Work on grasses and pasture legumes has drawn heavily on the experience of the CSIRO in Australia and a considerable interchange of biological material and research findings has taken place. Currently, a large number of commercial cattle producers have

extensive pasture improvement programs and Zimbabwe has become, in recent years, an important exporter of improved grass and legume seed.

This on-going research program and the immense amount of basic data already collected, offer good prospects for extending these methods and technologies to the communal areas. However, considerably more work will have to be done in the socio-cultural field on the possibilities and problems that will be found because of the communal grazing rights applicable in these areas.

4.2.3 Veterinary Services

In the 1890s after a serious outbreak of rinderpest which killed almost 95% of the cattle in the country, cattle were imported from East Africa. These cattle brought with them a virulent strain of Theileria (East Coast Fever). This disease rapidly spread through the country as the tick vector was present and the local cattle were completely susceptible.

The control and eradication of East Coast Fever in Zimbabwe is acknowledged as one of the greatest achievements of veterinary science in sub-Saharan Africa. The campaign spanned 50 years and was dependent on preventing cattle movement, separation and slaughter of infected cattle and the removal of cattle from infected pastures. Dipping was also used to control the tick vectors and, from the 1920s, compulsory dipping of cattle was introduced in Zimbabwe. All cattle in both commercial and communal areas must be dipped weekly during the summer and every five weeks in winter.

The last outbreak of the East Coast Fever occurred in 1954 and the continual dipping regime resulted in very effective control of this disease and a number of other endemic diseases. The serious stock

loss that occurred in the communal areas during the seventies, when the liberation war disrupted dipping services, demonstrates the heavy background disease problem that exists. The re-establishment of dipping and the increase in the distribution of dip tanks in the CAs has been given a high priority by the Government. The effective control of tick borne diseases is now being extended under the Department of Veterinary Services program of animal health care centers to other livestock problems. The coverage and success of these services in Zimbabwe has tended to direct veterinary research into dipping control measures rather than into attempting control through vaccine induced resistance.

4.2.4 Tsetse Research

The successful eradication and control of tsetse fly in large parts of Zimbabwe has been one of the most successful programs of its kind in Africa. Currently, thousands of hectares of land are being freed from one of the continent's most important scourges. The major thrust in tsetse research has been on the fly's ecology, life-cycle and behavioural patterns, which have formed the basis of improving the effectiveness of ground and aerial spraying, the holding of the fly with game and cattle fences and the monitoring of fly populations. Considerable research work has also been undertaken on odor attractants and male fly sterilization with a number of international organizations. This work in Zimbabwe has received international acclaim.

The tsetse department is committed, over the next few years, to pushing the fly belts in along Lake Kariba in the north and the launching of an eradication and holding program in the north east, where there is continual re-invasion of the fly across the Mozambique border. The program has received considerable international aid and the exercise has been run with the efficiency of a military campaign.

4.3 The Transmission of Agricultural Innovations

In sections 4.1 and 4.2 above, an indication is given of the level of adoption of the numerous research-generated innovations in Zimbabwe. In this section, the mechanism that has ensured this transfer is considered.

While pricing policy and numerous other mechanisms can result in the adoption of new innovations, the major vehicle is always considered to be the extension services.

4.3.1 The Extension Service

The structure of the extension service is explained in section 1.3.2.1. The extension service provided to commercial farmers in the past was exceptionally professional and is thought to have played an important part in the spectacular yield increases achieved by this group through the wholesale adoption of improved technologies detailed earlier in this chapter.

The commercial farmers have tended, since Independence, to rely heavily on commercial seed, fertilizer, chemical and stock feed companies to provide agricultural advice. In addition to these sources, this group of farmers regularly uses the advice and information supplied by the various commodity producer associations of the CFU and on the advisory services of organizations like TRB and ART. The farmers are formed into intensive conservation area committees (ICAs) and many individuals are highly competent and advanced agri-businessmen. They have access to a number of publications in the form of newsletters and magazines which also keep them abreast of the latest research results. Some claim that many of these more advanced farmers are in fact running ahead of the level of advice that could be supplied by an extension service and they actually need very little in the way of the persuasion and

information transfer that are a classic function of this sort of service.

The situation in the CAs is somewhat different. In the past, the extension service in these areas tended to have a message which was largely based on the more advanced technological innovations which were generated by the research service. These innovations often required a fairly high level of inputs and the technological package on offer tended to exclude the majority of poorer farmers. In the sixties, the extension service in the communal areas devoted a considerable effort to what were called master farmers. This concept, which originated in the thirties, required farmers to attend regular training sessions, and to be assessed over 2 seasons on the degree of implementation of these new methods in their farming practices. The classic North American approach to extension was used to describe this group of more advanced farmers as the "innovators" while the majority of farmers were classed as the "laggards". Even a cursory analysis of this approach revealed that the resource base required to adopt these complex series of innovations prevented the majority of farmers from participating.

In fact the extension service, by using this method, tended to devote an inordinate amount of time to the better-off farmers and thereby further increased the income differentials that existed. Justification for this extension methodology was again based on the "across the fence" or "trickle down" theories of extension. Some aspects of this process obviously happened as is demonstrated by the high adoption rate of very visible innovations such as hybrid maize.

In Natural Regions IV and V, the poor research base applicable to these areas made the extension recommendations even more unsuitable to the majority of farmers. The level of inputs required, coupled with the high degree of risk caused by the erratic rainfall, meant

that the average peasant producer could not implement much of the extension agent's advice.

A further problem has been the extension services' bias towards crops like maize (basically unsuitable for large parts of the country) and non-food cash crops like cotton, burley or oriental tobacco and sunflowers. Many argue that the promotion of these crops have made the risk of crop failures higher in the more marginal areas and significantly reduced the range of minor food crops so important to a more balanced diet. The predominance of maize and the decline of groundnuts, bambara nuts and chickpeas have significantly reduced the quality of diet in many rural areas. It is not uncommon to find extension workers who are completely conversant with the technologies required for growing cotton, yet are unable to even supply the local names of the most commonly grown sorghums in their area.

Since Independence, the extension service has done a considerable amount to broaden its extension base to include a greater proportion of farmers. This has been achieved by extending the use of groups in extension to include women's clubs, saving clubs and ordinary farmer groups. Currently, the World Bank is funding and helping to monitor a number of pilot projects that include the training and visit system (T&V), group listening activities using radios or cassette players and a concept where local farmers are recruited to help the efforts of extension workers by acting as community liaison persons.

These new approaches and a greater commitment to all groups in the CAs is encouraging. However, until there is a change in the basic orientation of the training of extension workers, coupled with the gradual replacement of the old extension workers who appear to find the necessary re-orientation in approach difficult, the problem will persist. Possibly the most important part of this new orientation is the need for research-generated innovations better suited to the actual conditions facing farmers in Natural Regions IV and V. Until

these new methodologies are fully developed and tested, many of the extension workers will only be able to offer advice and training on innovations that do not fit the environment in which farmers operate.

Given the problem mentioned above, one is forced to consider in Zimbabwe, a question asked in the ISNAR/IPFRI report (1981) "What is the optimum balance between investment in research and extension systems?".

It appears that further investment in extension may be somewhat pointless until the appropriate technologies are developed for the drier parts of the country where the majority of peasant producers currently operate. This is obviously not the opinion of the World Bank which has just embarked on the National Agricultural Research and Extension Projects in Zimbabwe. This allocated 57% of the funds to extension and 43% to research.

A World Bank sector policy paper on agricultural research published in 1981 advocates raising expenditure on research so that the balance of investment is about 1 : 1. An analysis of recent Zimbabwean Government budget allocations to research and extension is presented in Table 33 below.

The analysis is only possible for the period from 1978 onwards when the Department of Agricultural Development (DEVAG) was separated from the Ministry of Internal Affairs. This department provided an extension service for the CAs. The discrepancy between CA and CFA allocations is also shown in Table 16(b). (Between 1978 and 1980, the extension service for the commercial farming sector received on average 58% of the total extension allocation to the communal area which contains over 100 times more farmers).

Table 33: The Ratio of Budget Allocations Between Research and Extension in Zimbabwe for the Period 1978-1985.

Budget year	Research	Extension
1978/79	1	1.58
1979/80	1	1.69
1980/81	1	1.55
1981/82	1	1.98
1982/83	1	1.78
1983/84	1	1.88
1984/85	1	1.84

Source: Calculated from figures presented in Table 16.

The figures in this table show that in Zimbabwe the allocation to research is generally below 60% of allocation to extension. Given the dirth of suitable innovations for larger proportions of the CAs, this difference could be considered to be a misallocation. If, however, the research system starts to generate crops and innovations better suited to the drier Natural Regions, the country should be well placed to rapidly extend these techniques to the communal farmers in these areas.

4.4 Gender Issues

Since Independence, some progress has been made in Zimbabwe on improving the position of women in society. A number of studies and international conferences have highlighted the plight of women in Zimbabwe under tribal law where they were treated as legal minors. Some recently introduced laws have attempted to rectify this situation although a change in the general societal attitudes towards women will be a slow process. In rural agriculture, women form the backbone of the labor force.

Zimbabwe's rural areas are characterised by a preponderance of women in the working age cohort. A study of the 1969 census showed that in the age group 25 - 29 in the rural areas, women outnumbered men by

two to one. Women over 15 years old accounted for 27% of the CA's population as against only 18% for men. (Kay, 1970).

This phenomenon was caused by the process of male labor migration which has been a common feature of colonial development in central Africa. In the pre-Independence period, various restrictions prevented the male labor migrants from bringing their families to the centers of employment. More fundamentally the lack of job security and social benefits forced migrants in the wage sector to maintain their usufructory land rights in their CAs.

The high degree of absent male household heads in rural areas, ranging from 38.6% - 47.5% in a recent study, (Bonnie, 1982), has created a situation where a large number of rural farms are managed and run by women. This managerial role placed on women has not been matched by a shift in societal mechanisms to allow them the necessary freedom to play a significant role in the decision making process so critical to efficient farming. This results in many of the adverse effects that migrancy has on rural agriculture. Thiesen (1978) showed that the absence of a household head can result in a 25% fall in production.

The predominantly female farming population has, in the past, been largely missed by the extension service. The extension workers in Zimbabwe are all male and cultural restrictions on visits to homesteads where the husband is absent resulted in significantly different adoption rates on what are largely female crops, for example, groundnuts. A survey in the seventies on the adoption of innovations in Mashonaland revealed some interesting trends:

Table 34: Rate of Adoption of various technologies in Maize and Groundnuts in Mashonaland East Province

Crop	Maize	Groundnuts
Use of certified seed	69	5
Use of grain protectant chemicals or groundnut seed dressings	79	8
Stooking of maize or use of drying racks for grits	80	20

Source: Department of Agricultural Development Survey (1978)

The figures clearly illustrate the low adoption rate of groundnut technologies. In higher rainfall areas, the use of expensive chemical fertilizers (initial compound plus top dressing) on maize leads to yield increases of the order of 5 times, while the use of small amounts of relatively cheap gypsum on groundnuts can result in a doubling of yields. However, the adoption rates of these improved groundnut technologies are very low in comparison to fertilizer use in maize.

These low rates of adoption in the groundnut crop are indicative of both the low level of extension advice received by women and their inability to ensure that funds are available for the purchase of inputs for their own crops.

The recent re-orientation towards group extension efforts and the newly acquired political power of women's groups in the rural area have gone some way towards improving the flow of agricultural advice to this previously neglected sector of the rural population. However, the more equitable access of women to cash inputs for their own farming and gardening activities will require considerable restructuring and change in current rural attitudes and societal mechanisms. A start on this process has already begun, aided

considerably by the important and active role that women played in the liberation struggle.

The general changes experienced in rural agriculture in Zimbabwe, many of which are a direct result of research, have had a significant impact on women. Many of the new technologies adopted over the years have meant a considerable change of the labor requirements in rural crop production.

The adoption of hybrid maize and the use of chemical fertilizers have propelled this crop into a more important position in the cropping enterprise. The shift towards this crop has increased the labor demand, especially for initial weeding (the crop being more susceptible to weed pressure). The move from a multiple grains cropping pattern towards an almost mono-culture of maize makes it vital that family labor is devoted to this crop if some element of food security is to be ensured.

This increased and more intensive labor requirement of hybrid maize has resulted in a heavier work load for women. This change in labor input has resulted in a decrease in the time available for women's traditional gardening activities. In many rural areas the women's homestead gardens normally devoted to numerous small scale food crops and vegetables such as chickpeas, bambara nuts, groundnuts, etc. have shrunk either because of labor or land shortages. It is now common to find maize occupying this area although this crop is still intercropped with pumpkins, melons, and occasionally edible beans. The deliveries to the Grain Marketing Board of maize and other controlled crops must be made on a registered grower's number. This is often the male household head and it is he who receives the check payment for the delivery.

The mechanism ensures that men retain control of the family finances, in spite of the fact that women make most of the contribution in the form of labor.

4.5 Other Effects of Agricultural Production

The past orientation of research towards commercial agriculture has partly helped to maintain the large differential in income between the commercial and communal sectors. Despite the large discrepancies in the resource base, the continual expansion in yields among the commercial farming areas has enabled this sector to maintain its dominant share of the total marketable surplus in the country.

In the CAs, the extension message based on trickle down of commercially orientated research has equally created considerable disparities in incomes in these areas. The better-off farmers have been able to more easily adopt the suggested innovations and thereby increase their farming incomes. The poorer farmers and women have generally missed out on the direct benefits that have resulted from overall increases in the agricultural production in the CAs.

The rapid increase of cash crops, like cotton, have significantly reduced the diversity of the diet in the peasant areas. This change must have resulted in a lowering of nutritional status, especially among children, who have problems coping with the high bulk of maize meal.

4.6 Innovations with potential impact

The new orientation at R&SS towards adaptive research in the CAs using a systems perspective holds tremendous promise. A substantial research effort directed towards the producers in these areas may go

a long way towards improving the quality of life and redressing many of the imbalances that currently exist.

The development of maize varieties with a high lysine content could serve as an important way of improving the vital amino acid deficiency that characterises the crop.

Research on small grains could result in crops better suited to the drier areas of the country. This in itself should improve the food security situation and hopefully remove from Natural Regions IV and V the periodic food crop failures and subsequent hunger that normally occurs during their frequent droughts.

Research on crops like cowpeas and field beans could, if successfully extended to the communal areas, help in the overall improvement of the nutritional status of farm families. The development of a rosette virus-resistant groundnut variety would significantly increase the communal areas' production of this important food crop.

Expansion of research on small stock such as goats and sheep, if it improved productivity, would also improve the level of protein intake as these animals are more often slaughtered than cattle.

4.7 The Contribution of the IARCs

As was stated at the beginning of this report, the IARCs have only played a limited part in agricultural research in Zimbabwe. CIMMYT's role in wheat varieties has been elucidated earlier.

There are, however, a number of areas mentioned in the previous section where the current collaboration of some international centers could make a significant contribution to agricultural production.

These are detailed below:-

CIMMYT, ILCA and possibly ICRISAT in Farming Systems Research.

IITA in grain legumes such as cowpeas.

ICRISAT in sorghum, millets and groundnuts.

ILCA in cattle and small stock productivity.

Most of the IARCs have an important role to play in providing encouragement and training for the research system in the country. For this collaboration to be fully effective, they will have to gear the training they offer more towards the specific needs of the NARS. ISNAR should have an important role in helping R&SS draw up an effective long term training policy.

All the IARCs have an important function in promoting interaction and collaboration between the individual NARS in the countries in the SADCC region. Unfortunately, at the present time, it is the NARS that is forcing the often reluctant IARCs to collaborate in intergrated regional programs.

The trend of commercial agriculture towards private funded research opens the opportunity for some IARCs to make a significant contribution in sustaining the important role that this sector plays in ensuring overall food security in Zimbabwe. Here CIMMYT, on wheat and maize (also IITA), could, by directly collaborating with local seed companies and organizations like the Agricultural Research Trust, help these bodies with their crop breeding programs.

CHAPTER FIVE

CONCLUSIONS

Between November 1965 and April 1980, Zimbabwe (then Rhodesia) was almost totally isolated from the international agricultural research centers and specifically prevented from communicating with centers based in Africa and on the Indian Sub-continent. This isolation, because of international sanctions applied after the Unilateral Declaration of Independence, has meant that most of the CGIAR network of centers have only been collaborating with the country's research system for a relatively short period. This short time span of four years has precluded the possibility of IARC contributions having a significant impact on local production patterns and levels. For this reason, the measurement of impact in quantifiable terms has largely been impossible. The effect of the centers' collaboration with the research system in Zimbabwe has had to be evaluated on the basis of the perceptions and opinions of staff in the system, their views of the quality of this interaction and on their interpretation of possible future impact.

The research system in Zimbabwe has had a history of sound production-orientated research spanning the last seventy years. The research in the pre-Independence period was largely directed towards large-scale commercial farmers and the research results have been translated into spectacular yield and productivity increases in this sector. This transfer of research findings into "on-farm" yield increases, is partly a reflection of the quality and practical orientation of the country's agricultural research efforts. However, contributory to this has been a clearly defined national policy which provided the necessary institutional infrastructural and financial support for these commercial farmers.

In addition to this sub-sector's good resource base, in terms of size of holdings, suitable soil types and more favourable rainfall, the country's pattern of development provided a good transport infrastructure, (both road and rail), which enabled the transportation of surplus production to the well-distributed marketing facilities. A sound producer price policy, ample credit, financial support and relief during the difficult post-UDI years, as well as assistance in times of drought, ensured their financial viability and continued growth.

The advanced nature of agricultural research in Zimbabwe is clearly illustrated by the country's maize breeding program which released a commercial hybrid as early as 1949 (the second country in the world to achieve this after the USA). Subsequently, local breeders produced the now internationally renowned SR52, a high yielding hybrid still in large scale use today in both Zimbabwe and other countries. The development of the shorter season hybrids such as R200 and R201 in the seventies, led to significant yield increases and an expansion of maize in the more marginal rainfall areas.

Equally indicative of the strength and competence of the agricultural research system was the country's ability to rapidly diversify from its heavy dependence on tobacco after the imposition of international sanctions. The development of the cotton, soya bean and wheat crops were all based on extensive research. The adoption of and rapid expansion of these crops was again facilitated by good extension, price policy and investment support (especially for irrigation development).

The one international center which collaborated with Rhodesia throughout its period of enforced isolation was CIMMYT. This center, because of its longer involvement with the country has made a contribution to the agricultural system in the country. The center

has supplied wheat varieties which have formed the genetic basis of numerous locally adapted and crossed varieties. Some CIMMYT varieties have been released directly and are currently in use in Zimbabwe.

This CIMMYT biological material has made an important contribution by ensuring a steady release of new varieties which have avoided a build-up of rust problems in the crop. This collaboration and the provision of new varieties by CIMMYT clearly illustrates the difficulty of attempting to measure or quantify the impact that international centers can have in a country. The local wheat crop is entirely grown under irrigation and, without the incentives provided by government to encourage investment in irrigation development, the means to produce the crop would not exist. Further, the original dwarf varieties released in the sixties were entirely the work of local breeders. The competent and professional nature of the local breeders have been instrumental in the rapid adaptation, testing and release of the CIMMYT varieties. To attempt to isolate or apportion the contributions made by either the international center, the national research staff, or the supportive mechanism supplied by government policy would, in fact, do a disservice to all three components. The success of CIMMYT wheat material in Zimbabwe is a clear indication of the sort of beneficial contribution that international centers can make by collaborating with a strong, motivated and efficient national research organisation. It is also indicative of the fact that without the prerequisite support of a balanced and viable national agricultural policy, the best of biological material will unlikely make much of an impact. Where the objectives of a country match with the material, services or support that the international centers can provide, then there is a real possibility that the collaboration will result in some meaningful benefits.

Since Independence in 1980, there have been considerable changes in the policy and objectives of the national agricultural research system in Zimbabwe. In the light of this new direction, it is clear that many of the other international centers may have a significant influence in the future where they coincide with the needs and requirements of Zimbabwe's current research efforts.

The majority of the communal areas in Zimbabwe (where some 55% of the population live), are in portions of the country where rainfall is both lower and more unreliable. Very little research has been done to address the problems faced by these farmers. It would be unfair to suggest that these rural producers have not benefited in any way by previous research in Zimbabwe. A large proportion of these farmers have directly benefited from the high yielding and short season maize hybrids developed and released as a result of research. The research on cotton has made it a viable cash crop for an increasingly large number of peasant farmers. A large number of other smaller but important innovations have been developed as a result of research, and their adoption by the residents of the communal areas have resulted in improvements in both yields and productivity.

However, there still exists considerable need for research into the specific circumstances under which the communal producers operate and the research organisation, in line with the new government's policy, has started to devote more of an effort towards this end.

This new commitment has necessitated the use of a rapid information gathering technique to understand the constraints of the total farming system and to identify leverage points where meaningful research can be undertaken. Coupled with this is the strong belief that research trials should be conducted more under the actual conditions facing the farmers. This new orientation has coincided with the services that CIMMYT's regional economics program had to

offer in the form of on-farm experimentation with a farming system's perspective. Although CIMMYT in no way claims to be the sole purveyor of Farming System Research techniques, its early involvement after Independence with the Department of Research and Specialist Services, the Extension Service and the Department of Land Management has made a significant contribution in establishing the credibility of this form of research. Collaborative F.S.R. programs in the country, training of key personnel and the establishment of an annual series of regional workshops run jointly with the University of Zimbabwe, have resulted in a clear commitment towards F.S.R. The newly-formed F.S.R. unit in Research and Specialist Services has now established links with other international centers which also have F.S.R. programs, in particular ILCA. There are high expectations that this research methodology will enable the research system to rapidly develop research programs which will generate useful technologies for the communal areas.

Part of the communal farming system that has received very little research effort is the small stock (goats and sheep) which form such an important component of the livestock system. It is hoped that the previous experience of ILCA in this field will be useful.

Prior to Independence, no work had been done on the minor crops grown in the communal areas. In 1980, the national research system decided to look more closely at cowpeas, sweet potatoes and to a lesser degree, cassava. This new effort on these crops has been able to draw on the considerable experience of IITA. The supply of specific training and high quality material by IITA has enabled this program to advance rapidly. The material supplied by the center has been used as the basis for a local research program undertaken by the Agronomy Institute which has not had to go through the time consuming task of first developing a breeding program in these crops.

The trend in Zimbabwe's communal areas over the last 10 - 15 years has been for maize to replace the smaller grains (sorghum, bullrush millet and finger millet). The dangers of this trend have been brought to the fore during the last three years of drought. Some areas of Zimbabwe have experienced three complete failures in the maize crop. Many farmers have reverted to the more drought resistant small grains. The local varieties do not have a very high yield potential and previous breeding work in Zimbabwe has concentrated on red brewing sorghum hybrids. The recent establishment of an ICRISAT regional sorghum and millet program in the country is thought by many to have the largest potential future impact on peasant agriculture. The development of suitable white sorghums for the drier areas of Zimbabwe will make a substantial contribution to the long term food security situation.

The new commitment to the communal areas' crops may ultimately benefited by the efforts of IBPGR which collaborated with Research and Specialist Services in establishing a germ plasm collection of local varieties. This exercise further illustrates how some centers may only have a meaningful impact at some future date. The establishment of just such a collection is a long term investment which may be extremely important in providing useful genetic material for some future breeding program.

The immediate post-Independence period has been characterised by a significant loss of experienced research staff both through emigration and by loss to the private sector. This, coupled with the policy of rapid promotions of some of the remaining research workers into senior administrative positions and rapid recruitment of new staff has created a fairly youthful and inexperienced cadre of research officers. This situation has resulted in a real need for a service provided by all the IARCs, relevant research training. The centers have responded by offering a variety of training courses to the staff of R&SS. Some of these training courses have been a very

useful input for young post-graduates, who lack the necessary experience in practical research. Where the courses affected have been in fields in which the research service had little or no experience their impact has been significant. In the more established disciplines, the training has not really led to an increase in locally useful research techniques or skills.

However, it is generally accepted that most trainees have benefited from the exposure to the professionalism and research excellence which characterise all of the international centers. This form of life experience is, however, too costly to justify, given the benefits that accrue. Many of the participants in courses have complained that some of the training is too basic and the teaching level is geared to the least qualified participants. This criticism is possibly more a reflection that Zimbabwe, being a new entrant into this form of training opportunity, is tending to send professional officers on courses which are designed more for technical officers and research technicians. There are, however, examples where centers, by allowing more flexibility in their training program, have enabled the more qualified participants to use the time allocated to inappropriate subjects to work and interact with scientists involved in the center's on-going research program. This greater degree of flexibility, exhibited by ICRISAT for example, makes the training experience much more useful to this class of trainee. This approach would require a considerable degree of effort by the training departments of the centers to tailor-make a program to fit the participant's particular interests and ability. However, this additional effort would appear to be justified considering the expense of international travel and the sacrifice that the national research program makes in releasing critically needed research personnel for training.

Equally important in the field of training is for the national agricultural research system to have a clear and organized long-term

manpower development plan. In this respect, a recent mission by ISNAR to help R&SS formulate a training policy will be a useful form of collaboration. The department already has access to a considerable volume of funds for training at both the post-graduate and technical level, and a sound and implementable training policy would go a long way towards ensuring the continued improvement and future potential of the research system.

The loss of staff by R&SS has created another situation where the collaborative assistance of international centers would be helpful. A considerable amount of research data in Zimbabwe has not been analysed. This is particularly true of livestock research where staff changes and resignations have left ongoing programs which have continued to generate raw data. This data requires analysis and interpretation to enable the findings to be extended to farmers and new directions in research determined. ILCA has already started making a contribution by providing support and assistance to researchers in the form of computer data analysis. In addition, the center has just completed an exercise involving the micro-ficheing of a vast number of published and unpublished documents on livestock.

The potential exists for a number of centers to make a long term and important contribution to research in Zimbabwe. The current strength of some national programs or the difference in priorities between the national and international centers research may affect this potential. For example, it is unlikely that CIMMYT will have much impact on the maize program, CIP on the current potato breeding program, or IITA on the soya bean program. The policy of tsetse eradication in Zimbabwe makes ILRAD's development work on a trypanosomiasis vaccine of limited long term importance.

The good infrastructure, reasonable funding and dynamic nature with which the research system is blessed in Zimbabwe, opens the vista to useful interaction and collaboration with international centers. The

basis for this collaboration must be a deep understanding of the pattern and path of research in Zimbabwe on the part of the centers. This requires regular contact and discussion. The flying short-term visits common to many of the international center staff is not the vehicle for this development. Nor are the often unco-ordinated activities and at times competitive rivalry between centers helpful.

The establishment of regional offices and programs is useful as it enables the center to have a more meaningful interaction. In addition, these specific regional activities enable the centers to contribute in a multilateral fashion to the improved communication and collaboration among all the countries in the East and Central Africa. This form of development should be given a high priority by the international centers.

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7. APPENDICES

7.1 Persons Visited

Dr. P. Chigarro	Director, R&SS.
Dr. B. Ndemande	Deputy Director, R&SS.
Dr. J. Grant	Assistant Director (Livestock), R&SS.
Dr. E. Whingiri	Head of Agronomy Institute, R&SS.
I. Mariga	Agronomist, Agronomy Institute, R&SS.
R. Oliver	Head of Crop Breeding Institute, R&SS.
K. Machingaidze	Maize Breeder, CBI, R&SS.
A. Chiteka	Groundnut Breeder, CBI, R&SS.
M. Joyce	Potato Breeder, CBI, R&SS.
J. Musonga	Sorghum Breeder, CBI, R&SS.
A. Mashiringwani	Wheat Breeder, CBI, R&SS.
Dr. S.S. Mlambo	Head of Plant Protection Research Inst. R&SS.
G.G. Rabey	Head of Cotton Research Institute.
Dr. E. Jones	Head of Lowveld Research Station, R&SS.
I. Marapara	Agronomist, Lowveld Research Station, R&SS.
M.D. Nzima	Horticulturalist, Lowveld Research Station, R&SS.
H.K. Ward	Head of Station, Matopos Research Station, R&SS.
H.P. Tawonezvi	Head of Station, Makoholi Research Station, R&SS.
Dr. C.T. McCabe	Head of Station, Henderson Research Station, R&SS.
Dr. M. Avilla	Head of FSR Unit, R&SS.
E. Shumba	Agronomist, FSR Unit, R&SS.
B. Mombeshora	Livestock Specialist, FSR Unit, R&SS.
Dr. J. Hargreaves	Assistant Director (Field), Dept. of Veterinary Services.

Dr. P. Madzima	Assistant Director (Research) Dept. of Veterinary Services.
Dr. J. Hargroove	Principal Research Officer, Branch of Tsetse and Trypanosomiasis Research.
Prof. M. Blackie	Dean of Faculty of Agriculture, U of Z.
Prof. M. Schweppenhauser	Head of Crop Science Dept., U of Z.
Dr.D. Cole	Senior Lecturer, Crop Science Dept., U of Z.
G. Hilderbrand	Senior Research Fellow, Crop Science Dept., U of Z.
A. Rowe	Lecturer, Crop Science Dept, U of Z.
Dr. M. Rukuni	Lecturer, Dept of Land Mangement, U of Z.
Dr. J.S. Cole	Assistant Director (Research), Tobacco Research Board.
K.E. Cackett	Officer in Charge, Zimbabwe Sugar Association Experiment Station, Chiredzi.
R. Winkfield	Commercial Grain Producers Association, Commercial Farmer Union.
Dr.J. Oliver	Director, Agricultural Research Trust.
Dr. L. House	Sorghum Breeder, ICRISAT.
Dr.E. Nunn	Project Manger, ICRISAT Regional Sorghum and Millet Program, Matopos Research Station.
Dr. M. Collinson	Economist, CIMMYT Regional Office, Nairobi.
Dr. P.Ananda	Training Officer, CIMMYT Regional Office, Nairobi.
Dr. J. Deutch	Agronomist, CIMMYT, Mexico.

7.2 Places Visited

Agricultural Research Centre, R&SS, Harare.

Hendersen Research Station, Mazowe.

Matopos Research Station, Matopos, Bulawayo.

Lowveld Research Station, Chiredzi.

Cotton Research Institute, Kadoma.

Makoholi Experiment Station, Masvingo.

University of Zimbabwe, Harare.

Zimbabwe Sugar Association Experiment Station, Chiredzi.

Tobacco Research Board, Kutsaga Research Station.

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